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MSFC-MAN-032

TECHNICAL MANUAL

S-IC STAGE

TRANSPORTING AND HANDLING

(THE BOEING CO.)

NAS8-5608

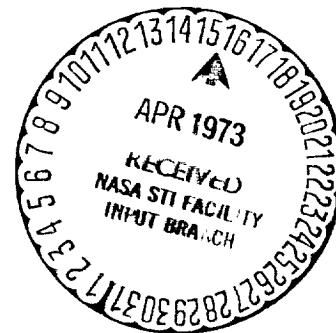


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INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

LIST OF EFFECTIVE PAGES

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page.

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 110 CONSISTING OF THE FOLLOWING:

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Appendix 2	Original				

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EFFECTIVE DESIGN CHANGES		
CHANGE NUMBER	DESCRIPTION	MANUAL DATE INCORPORATED
ECP 0623	Replace Vacco components in S-IC Pneumatic Console that do not have a 4 to 1 safety factor in burst pressure.	1 October 1971
ECP 0628	Implement the propellant tank pressure monitor and control unit as alternate equipment for S-IC tank standby pressurization at KSC.	1 October 1971

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SECTION I

GENERAL

1-1. INTRODUCTION.

1-2. This manual provides procedures for transporting and handling the S-IC stage. It covers the movement and erection of the S-IC stage at the Michoud Assembly Facility (MAF), the test stand at the Mississippi Test Facility (MTF), and the Mobile Launcher at the Kennedy Space Center (KSC).

1-3. S-IC STAGE DESCRIPTION. Stage description information is provided in technical manual MSFC-MAN-040, "S-IC Stage System Description".

NOTE

See technical manual index MSFC-MAN-000 for specific manual vehicle dash number.

1-4. S-IC STAGE HANDLING FITTINGS - REMOVAL. Procedures for removal of the handling fittings installed on S-IC stage are provided in technical manual MSFC-MAN-035, "Stage Buildup Procedures".

NOTE

See technical manual index MSFC-MAN-000 for specific manual vehicle dash number.

1-5. S-IC ERECTION, HANDLING AND SERVICING EQUIPMENT. Description and maintenance information is provided in technical manual TM-4-70-D, "Stage Erection, Handling, Servicing."

1-6. PRIME TRANSPORTATION AND HANDLING EQUIPMENT. The use of the following equipment will be covered in detail:

- a. S-IC Stage Transporter.
- b. Protective Covers.
- c. Tank Pressure and Control Equipment.
- d. Transportation Data Recording Equipment.
- e. Prime Mover with Auxiliary Power Unit.
- f. Transportation Barges.
- g. Cranes and Hoists.

1-7. SPECIAL TOOLS AND AUXILIARY TRANSPORTATION AND HANDLING EQUIPMENT. Additional support equipment will be listed in Section II and include in part; S-IC Forward Handling Tool, Aft Rotation Brace, Slings, Cherry Pickers, High Rangers, Fork Lifts, Trucks, Fire Engines and other vehicles.

1-8. CHECKOUT PROCEDURES. Checkout procedures for the prime transportation and handling equipment to be accomplished prior to S-IC stage loading or movement are contained in Section III.

1-9. PREPARATION FOR TRANSPORTATION. Procedures for the preparation of S-IC stage and transportation equipment for loading, operational verification and environmental protection prior to stage movement are contained in Section IV.

1-10. S-IC STAGE TOWING. Procedures for the operation of transporter, prime mover and supplementary equipment during towing are covered in Section V.

1-11. BARGE OPERATIONS. Procedures for S-IC stage barge loading, off-loading and enroute operations covering barge preparation, supplementary equipment checkout, S-IC stage tie-down and enroute monitoring are contained in Section VI.

1-12. TRANSPORTATION UNLOADING. Procedures for S-IC stage unloading from transporter and the removal of supplementary equipment are covered in Section VII.

1-13. S-IC STAGE HANDLING AT THE MICHoud ASSEMBLY FACILITY. Procedures for handling S-IC stage between locations at MAF and the erection and removal at the Vertical Assembly Building are covered in Section VIII.

1-14. S-IC STAGE HANDLING AT THE MISSISSIPPI TEST FACILITY. Procedures for S-IC stage handling at MTF covering stage erection and removal at the test stand and the utilization of S-IC booster storage building are contained in Section IX.

1-15. S-IC STAGE HANDLING AT THE KENNEDY SPACE CENTER. Procedures for S-IC stage handling at KSC involving barge unloading, transportation to Vertical Assembly Building, removal of supplementary equipment, and erection on the Mobile Launcher are covered in Section X.

SECTION II

SPECIAL TOOLS AND AUXILLIARY TRANSPORTATION AND HANDLING EQUIPMENT

2-1. INTRODUCTION.

2-2. This section provides a tabulation of special tools and equipment required to support the transportation and handling of the S-IC stage. No fixed facility items such as cranes, personnel work stands or, pressurized gas supplies are included.

FIGURE NO.	PART NO.	NOMENCLATURE	APPLICATION
3-5	90M00487	HAND PUMP ASSY., HYDRAULIC	S-IC Transporter Checkout.
3-5	90M01020	DEVICE, AIR GAUGE	
3-5	90M00558	REEL, CABLE STEEL	S-IC Transporter Checkout
3-5	90M00358	HOSE ASSY., ADAPTER	
3-5	90M00531	COVER CONSOLE	S-IC Transporter Shutdown
3-7		*GAGE PRESSURE, 0-30 PSIG	Verification of Tank monitor and control equipment.
3-7		*GAGE PRESSURE, 0-300 PSIG	
3-7		*GAGE PRESSURE, 0-5 PSIG	Verification of Tank monitor and control equipment.
3-7		*GAS SUPPLIES, REGULATED, 0-250 PSIG	
3-7		*VALVE, BLEED	Verification of Tank monitor and control equipment.
3-7		*POWER SUPPLY METERING VALVE, 115 (+10) VAC	
3-8	ADEL TE 9021 or FUTURECRAFT 90255	CALIBRATION UNIT, PORTABLE PNEUMATIC	Checkout/verification tank pressure and control equipment.
3-10	JOHN FLUKE 801 or equivalent	VOLTMETER, DIFFERENTIAL	Checkout/verification of transportation recorder.
3-10	SIMPSON 260	VOLTMETER	Checkout/verification of transportation recorder.
4-1	75M51012-1	PIN PULLER ASSY., 9 1/2 IN. PIN	Pull pin between S-IC stage and hoist.
4-1	75M51012-2	PIN PULLER ASSY., 5 1/2 IN. PIN	Pull pin between S-IC stage and hoist.
4-2	75M51018	SLING	Rotation Brace Installation.
4-2	75M51011	SPREADER	Rotation Brace Installation.

Figure 2-1. Special Tools and Auxiliary Transportation and Handling Equipment (Sheet 1 of 5)

FIGURE NO.	PART NO.	NOMENCLATURE	APPLICATION
4-2	75M51009	BRACE ASSEMBLY, ROTATIONAL	Load S-IC in Transporter. Unload S-IC from Transporter. Place S-IC into vertical position. Remove S-IC from vertical position. Load S-IC stage on mobile launcher.
4-3	75M51012-3	PIN PULLER ASSY., 4 1/2 & 5 IN.	Pull pin between S-IC stage and hoist.
4-3	75M51012-4	PIN PULLER ASSY., 3 IN.	Pull pin between S-IC stage and hoist.
4-3	75M51013	LINKAGE ASSY., ADJUSTABLE	Rotational Brace Installation.
4-4	75M51015	LIFTING ADAPTER ASSY.	Rotational Brace Installation.
4-5	90M00577	ADAPTER ASSY., A-FRAME	S-IC Transporter Loading.
4-5	90M01001	SUPPORT ASSY.	
4-5	90M00592	CABLE ASSY., 21W3	
4-5	90M00386	BRACKET ASSY., JACKING	
4-5	90M00600	CABLE ASSY., 21W5	
4-5	90M00599	CABLE ASSY., 21W4	
4-5	90M00591	CABLE ASSY., 21W2	
4-5	90M00546	PIN ASSY., 15 FT.	
4-5	90M00393	CYLINDER, A-FRAME	
4-5	90M00597	CABLE ASSY., 22W2	
4-5	90M00525	HOSE ASSY., SPECIAL EQUIPMENT	
4-5	90M00559	BRACKET ASSY.	S-IC Transporter Loading.
5-1		TRUCK, FIRE	Support for towing convoy.
5-1		VEHICLES, SECURITY (2)	Support for towing convoy.
5-1		TRUCK, 3/4 TON WITH PINTLE HOOK	Support truck for towing convoy.
5-1		TRUCK, 1/2 TON STAKE	Misc. equipment transport in towing convoy.
5-1	N/A	WOOD BLOCKS, 4 IN. x 4 IN. x 18 IN.	S-IC transporter shutdown. Load S-IC stage on barge. Transfer S-IC stage from transporter to Storage Stands. Transfer S-IC stage from Storage Stands to transporter. Transfer S-IC stage from one transporter to another transporter.

Figure 2-1. Special Tools and Auxiliary Transportation and Handling Equipment (Sheet 2 of 5)


FIGURE NO.	PART NO.	NOMENCLATURE	APPLICATION
6-2	5-1447	BENDING MACHINE	Load S-IC stage on barge.
6-2		DOLLY, LATERAL TIE-DOWN FIXTURE	
6-2		JACK, HYDRAULIC	
6-2		TOOL BOX	Checkout S-IC transporter with stage attached. Attach S-IC stage to transporter. Load S-IC stage on ocean going barge. Transfer S-IC stage from vertical to horizontal at MAF. Transfer S-IC stage from horizontal to vertical at MAF. Load S-IC stage on river barge. Transfer S-IC stage from transporter to Storage Stand. Transfer S-IC stage from Storage Stand to transporter. Transfer S-IC stage from transporter to another transporter.
6-2	AUSTIN-WESTERN	BOOM CRANE	Unloading S-IC stage from ocean going barge.
6-2		FORKLIFT, 15,000 POUND (PNEUMATIC TIRES)	Load S-IC stage on ocean going barge. Unload S-IC stage from ocean going barge. Load S-IC stage on mobile launcher.
6-2		DOLLY, TRANSPORTER	Load S-IC stage on ocean going barge.
6-2		FORKLIFT, 6,000 POUND	S-IC transporter shutdown. S-IC checkout transporter with stage attached. Attach S-IC stage to transporter. Attach/remove tow bar between prime mover and S-IC transporter. Transfer S-IC stage from vertical to horizontal at MAF. Transfer S-IC stage from horizontal to vertical at MAF. Load S-IC stage on river barge. Unload S-IC stage off ocean going barge. Transfer S-IC stage from transporter to Storage Stands. Transfer S-IC stage from Storage Stands to transporter. Transfer S-IC stage from transporter to another transporter
6-3	90M01970-1	ASSOCIATED EQUIPMENT	Load S-IC stage on river barge.
8-2		SUPPORT ASSEMBLY (HANDLING RING END)	Transfer S-IC stage from transporter to Storage Stands. Transfer S-IC stage from Storage Stands to transporter.

Figure 2-1. Special Tools and Auxiliary Transportation and Handling Equipment (Sheet 3 of 5)

FIGURE NO	PART NO.	NOMENCLATURE	APPLICATION
8-2	90M01970-1	SUPPORT ASSEMBLY (HANDLING RING END)	Transfer S-IC stage from transporter to another transporter.
8-2		MAINTENANCE AIR DOLLY	Transfer S-IC stage from transporter to Storage Stands.
8-2		SLING, 4-WAY, 1 IN. x 8 FT.	Transfer S-IC stage from Storage Stands to transporter.
8-2		SLING, 4-WAY, 3/4 IN. x 8 FT.	Transfer S-IC stage from transporter to another transporter.
8-2		SLING, 4-WAY, 3/4 IN. x 10 FT.	
8-2		HOISTS, 2-TON COME-A-LONG	
8-2		HOISTS, 3-TON COME-A-LONG	
8-2		HOIST, 60-TON A-FRAME MOBILE GANTRY	
8-2	MIT27-B470-10000	LIFTING LINKAGE	
8-2		AIR COMPRESSOR, 110 PSIG	
8-2		TRACTOR, 12,000 POUND DRAW BAR PULL (2)	
8-2		CHAIN, 3/8 IN. x 12 FT.	
8-2		CABLE, CHOKER 3/4 IN. x 8 FT.	
8-2	90M01956-1	TOWER ASSEMBLY	Transfer S-IC stage from transporter to another transporter.
8-3		FORKLIFT TRUCK, 20,000 POUND	Transfer S-IC stage from transporter to Storage Stands. Transfer S-IC stage from Storage Stands to transporter.
8-3		FORKLIFT TRUCK, 25,000 POUND	Transfer S-IC stage from transporter to Storage Stands. Transfer S-IC stage from Storage Stands to transporter.
9-1		CHERRY PICKER without BASKET	Attach S-IC stage to transporter. Transfer S-IC stage from vertical to horizontal at MAF. Transfer S-IC stage from horizontal to vertical at MAF.
9-1		CHERRY PICKER with BASKET	Transfer S-IC stage from vertical to horizontal at MAF. Transfer S-IC stage from horizontal to vertical at MAF. Load S-IC stage on mobile launcher.

Figure 2-1. Special Tools and Auxiliary Transportation and Handling Equipment (Sheet 4 of 5)

FIGURE NO.	PART NO.	NOMENCLATURE	APPLICATION	
9-1	HT3-B470-10000	LIFT-A-LOFT, 60 FT.	Attach S-IC stage to transporter. Transfer S-IC stage from vertical to horizontal at MAF. Transfer S-IC stage from horizontal to vertical at MAF.	
9-1		LIFT-A-LOFT, 40 FT.	Attach S-IC stage to transporter. Transfer S-IC stage from vertical to horizontal at MAF. Transfer S-IC stage from horizontal to vertical at MAF.	
9-1		LINK ASSEMBLY	Transfer S-IC stage from vertical to horizontal at MAF. Transfer S-IC stage from horizontal to vertical at MAF.	
9-1		90M00463	TRANSPORTER TOW BAR, 15 FOOT	Transfer S-IC stage from vertical to horizontal at MAF. Transfer S-IC stage from horizontal to vertical at MAF.
10-1		HIGH RANGER	Load S-IC on mobile launcher at KSC.	
10-1		CRANE, MOBILE, 12 TON PETTIBONE (OR EQUIVALENT)	Load S-IC on mobile launcher at KSC.	
.				

* LOX clean

Figure 2-1. Special Tools and Auxiliary Transportation and Handling Equipment (Sheet 5 of 5)



SECTION III
CHECKOUT PROCEDURES3-1. INTRODUCTION.

3-2. This section provides procedures for the initial checkout and shutdown of the prime mover with auxiliary power unit, S-IC stage transporter, tank pressure and control equipment and transportation data recording equipment prior to loading S-IC stage.

3-3. Checkout of the Prime Mover (M26-A1) (90M01072) and Auxiliary Power Unit is required prior to coupling with transporter.

3-4. Checkout of Transporter (90M00201) is required prior to coupling with Prime Mover.

3-5. Checkout of the Prime Mover and Transporter is required after coupling and all electrical and pneumatic connections are complete.

3-6. Checkout of the tank pressure, monitor and control system (65B64146-1) is required prior to installation on transporter.

3-7. Checkout of the transportation data recording equipment is required prior to installation on transporter.

3-8. M26-A1 PRIME MOVER CHECKOUT. Perform the following checkout of M26-A1 prime mover prior to operation per figure 3-1 as follows:

- a. Check each of ten tires for 90 (± 5) psi.
 - b. Check crankcase oil level and add SAE 30 crankcase oil if necessary.
- CAUTION**
- Protect radiator to -20°F .
- c. Check radiator and add water or ethylene glycol base anti-freeze if necessary.
 - d. Check fuel level and add regular grade gasoline if required.
 - e. Check all lights including turn signals for proper operation.
 - f. Start prime mover and allow engine to warm up.
 - g. Verify 90 (± 10) psi air pressure and check air brakes.
 - h. Bleed condensate from brake system reservoirs by momentarily opening drain valves.

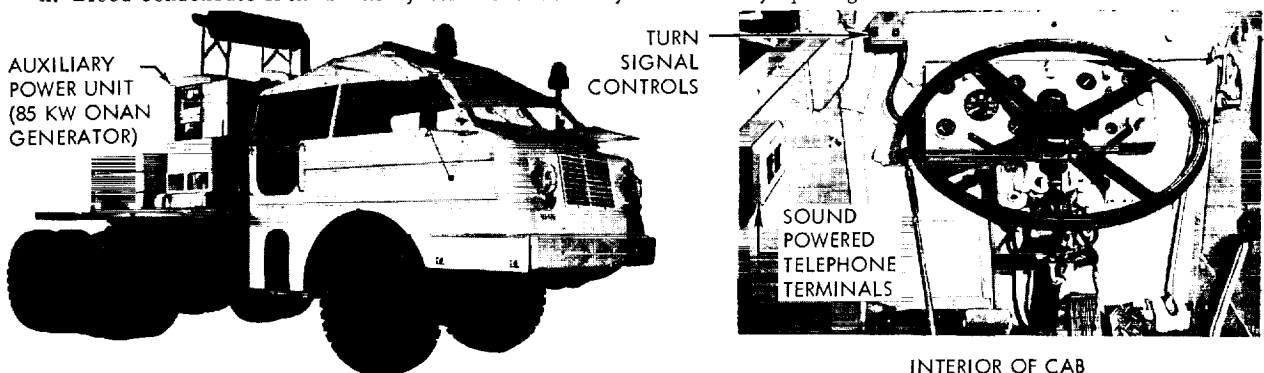


Figure 3-1. M26-A1 Prime Mover

3-9. PRIME MOVER AUXILIARY POWER UNIT CHECKOUT. Perform the following checkout of the 85kw Onan motor generator per figure 3-2 as follows:

- a. Check crankcase oil level and add crankcase oil (MD or MS per MIL-L-21044) as required:
 - (1) Below 0°F SAE 5 wt
 - (2) 0°F - 32°F SAE 10 wt
 - (3) 32°F - 90°F SAE 20 wt
 - (4) 90°F ABOVE SAE 30 wt
- b. Check level of oil in hydraulic governor and fill to proper level with Sunvis 916 SW or equivalent.
- c. Check intake air connections at air cleaner for security.

CAUTION

Protect radiator to - 20°F.

- d. Check engine radiator and add ethylene glycol base anti-freeze if necessary.
- e. Fill fuel tank with No. 2 diesel fuel.
- f. Check all fuel lines for security.
- g. Start the engine as follows:
 - (1) Push three reset buttons (5) on the generator control panel.
 - (2) Set main load circuit breaker (14) to OFF.
 - (3) Set field circuit breaker (10) to OFF.

CAUTION

If during operation the low oil pressure, high water temperature, overspeed trip mechanism should stop the generator, investigate and correct before attempting a restart.

- (4) Set switch (9) to RUN.

NOTE

If engine does not start within 30 seconds, wait one minute before trying to start again.

- h. Allow engine to warm up for approximately 15 minutes.
- i. Check instruments for the following:
 - (1) Oil pressure (8) 40 psi minimum.
 - (2) Water temperature (12) - 173 (+7) degrees.
 - (3) Ammeter (11) - positive charge
 - (4) Tachometer (7) - 1800 (+100) rpm.

(5) Fuel pressure (6) - 20 psi minimum.

j. After Engine warm-up perform the following adjustments:

- (1) Set voltmeter - ammeter selection switch (13) to position No. 1.
- (2) Energize field circuit breaker (10).
- (3) Check voltmeter (3) for 470 (+10) vac.
- (4) Adjust voltage regulator (4) for 465 (+5) vac on voltmeter.
- (5) Rotate voltmeter - ammeter switch (3) to positions 2 and 3 and observe that voltages are 465 vac. Return to position 1 for operation.

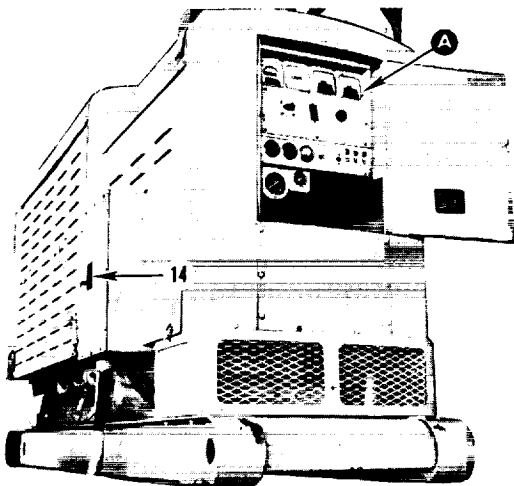
k. Unit is now ready for operation.

CAUTION

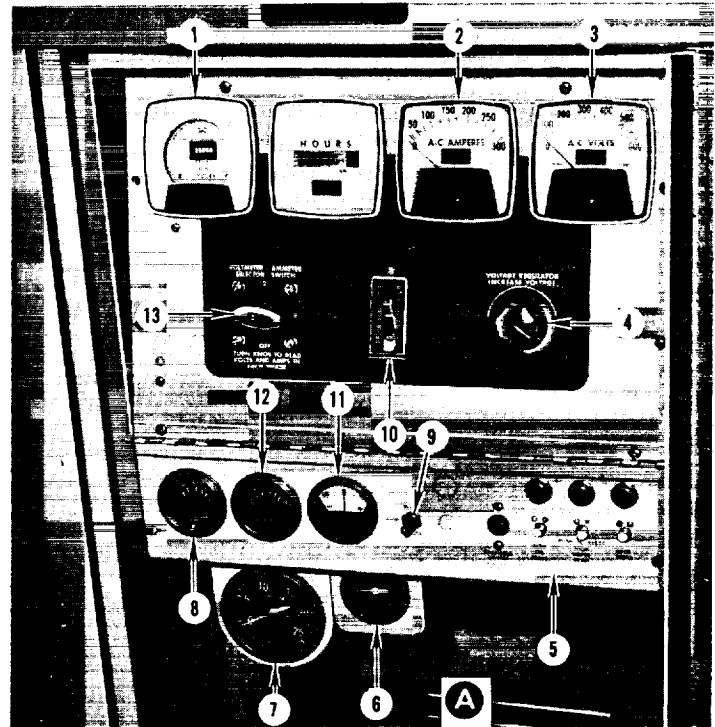
If during operation the low oil pressure, high water temperature, or overspeed trip mechanism, should stop the generator, investigate and correct before attempting a restart.

l. Shut down the generator as follows:

- (1) Set main load circuit breaker (14) to OFF.
- (2) Set field circuit breaker (10) to OFF.
- (3) Set start-run switch (9) to STOP.



- | | |
|---------------------|-------------------------------|
| 1 FREQUENCY METER | 9 START-RUN SWITCH |
| 2 AC AMMETER | 10 FIELD CIRCUIT BREAKER |
| 3 AC VOLTMETER | 11 AMMETER |
| 4 VOLTAGE REGULATOR | 12 WATER TEMPERATURE |
| 5 RESET BUTTONS | 13 VOLTMETER AMMETER SELECTOR |
| 6 FUEL PRESSURE | 14 MAIN LOAD CIRCUIT BREAKER |
| 7 TACHOMETER | |
| 8 OIL PRESSURE | |



CONTROL PANEL

Figure 3-2. Prime Mover Auxiliary Power Unit

3-10. CHECKOUT OF S-IC TRANSPORTER. Perform the following checkout prior to operation of the equipment and before coupling with the prime mover per figure 3-3 as follows:

- a. Check each of the 16 tires on the front dolly for 80 (± 5) psi.
- b. Check each of the eight tires on the rear dolly for 80 (± 5) psi.
- c. Verify front and rear dolly electrical circuit breaker boxes are free of foreign material.
- d. Check fluid level (thru sight glass, figure 3-6) of hydraulic reservoirs for the two front hydraulic packages and the single rear hydraulic package. Fluid should be at the indicated proper level when transporter is in the nominal height position.

NOTE

If it is necessary to add fluid, remove side plate and reservoir filler cap per figure 3-6 detail A. Add hydraulic fluid, Sunvis 916 SW or equivalent, as required. Replace filler cap and side plate.

- e. Perform a walk-around visual inspection of brake system for any obvious damage.
- f. Drain condensate from the two front dolly air brake reservoirs and the single-rear dolly reservoir by opening the drain valve momentarily.
- g. Check oil level in each wheel actuator. Add Type A automotive transmission fluid as required.

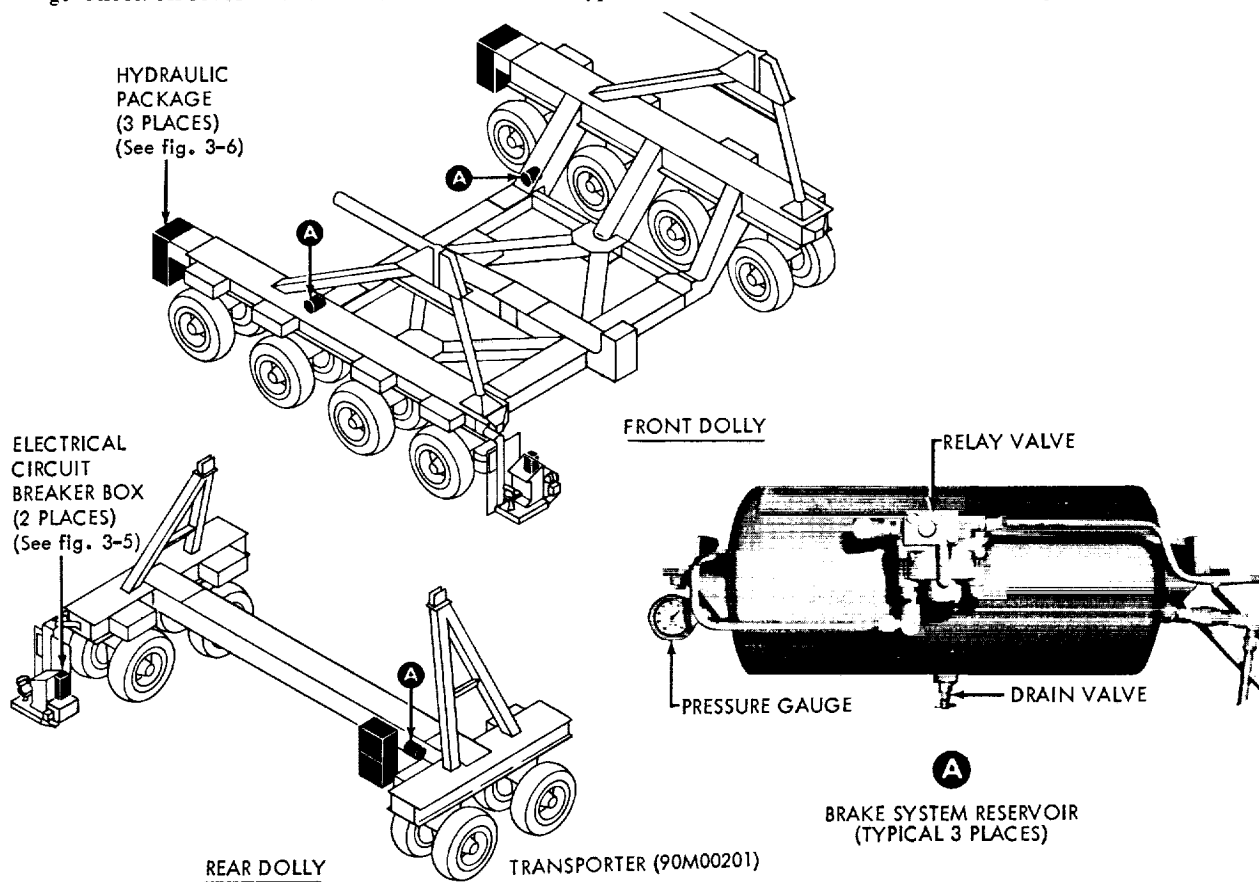


Figure 3-3. Checkout of S-IC Transporter

3-11. M26-A1 PRIME MOVER ATTACHMENT TO S-IC TRANSPORTER. Attach prime mover to transporter per figure 3-4 as follows:

- a. Prior to attachment perform all requirements of paragraphs 3-6 through 3-10.
- b. Install tow bar assembly (90M01813) on the front transporter dolly by inserting the attachment (90M00318) on the tow bar assembly into the bracket assembly (90M00515) per detail A.
- c. Install the pin assembly (7) (90M00323) and secure with ball-10k pin (6) (90M00309).
- d. Back the M26-A1 prime mover and connect the M26-A1 pintle hook (15) to the S-IC transporter tow bar per detail B. Verify the pintle hook is locked in place.
- e. Connect tow bar service air Wagner Coupler (90M00371) to Wagner Service Air Coupler (10) on left rear of M26-A1 prime mover.
- f. Connect tow bar emergency air Wagner Coupler (90M00363) to Wagner Emergency Air Coupler (13) on right rear of M26-A1 prime mover.
- g. Open the two hand valves (16) on the M26-A1 prime mover directly upstream of the air couplers per detail C.
- h. Connect the P-1 end of power cable assembly (11) (90M00505) to the 11W1J1 receptacle located at the rear center of the M26-A1 prime mover chassis.
- i. Connect the P-1 end of the communications cable assembly (12) (90M00442) to the communications extension cable from the prime mover cab.

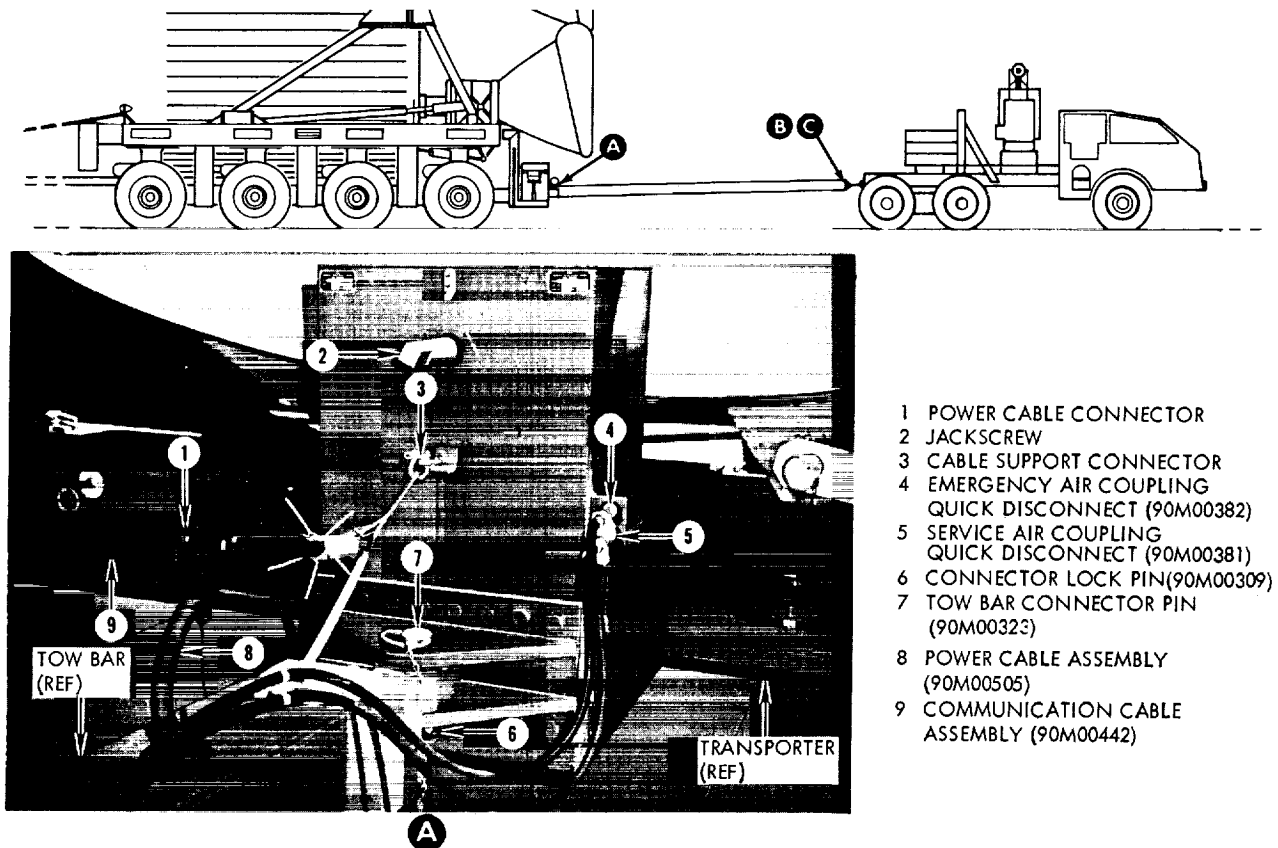


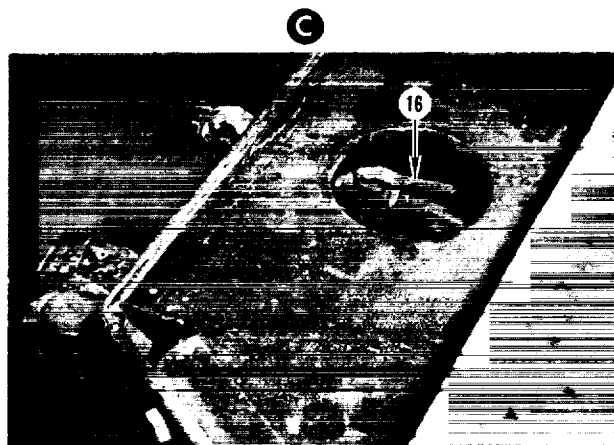
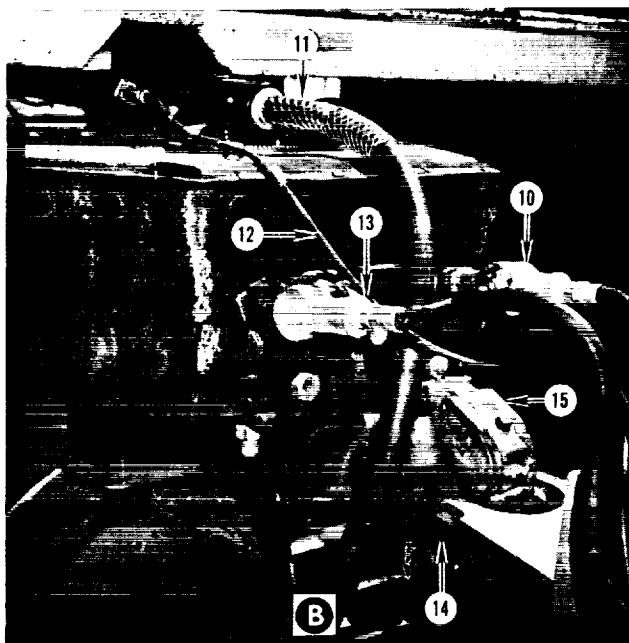
Figure 3-4. M26-A1 Prime Mover Attachment to S-IC Transporter (Sheet 1 of 2)

- j. Remove the dust caps from the service air coupling quick disconnect (90M00381) as identified by the adjacent tag and connect to the mating quick disconnect (5) on the transporter adjacent to the tow bar connection on the front transverse beam.
- k. Remove the dust cap from the emergency air coupling quick disconnect (90M00382) as identified by the adjacent tag and connect to the mating quick disconnect (4) on the transporter adjacent to the tow bar connection.
- l. Connect the P-2 end of power cable assembly (8) (90M00505) to the 31W0J2 receptacle located near the tow bar connection (1) on the front transverse beam.
- m. Connect the P-2 end of the communications cable assembly (9) (90M00442) to the 32W1-J2 receptacle located near the tow bar connection.
- n. Connect two (2) sound powered headsets to the prime mover J-box (figure 3-1) for the M26-A1 operator and the ground control.
- o. Connect two (2) sound powered headsets to the jacks provided on the front dolly console (figure 3-5) for the front dolly operator and the front observer.

NOTE

The following can only be accomplished after attaching stage to transporter per section IV.

- p. Install steel messenger wire between dollies by reeling cable assembly from winch assembly on the rear dolly (see figure 4-7) and connecting clevis on end of cable dead end tongue on front dolly. Tighten messenger wire until it has approximately two (2) feet of sag.
- q. Install interconnect cable assembly (90M00512) by wrapping cable hangers (detail C, figure 4-8) around messenger wire.
- r. Connect all air hoses, electrical and communications cables to fittings on both front and rear dollies.
- s. Connect the remaining two (2) sound powered headsets to the jacks provided on the rear dolly console (figure 3-5) for the rear dolly operator and the rear observer.



- 10 EMERGENCY AIR COUPLER (90M00371)
- 11 POWER CABLE ASSEMBLY (90M00505)
- 12 COMMUNICATIONS CABLE ASSEMBLY (90M00442)
- 13 SERVICE AIR COUPLER (90M00363)
- 14 TRANSPORTER TOW BAR
- 15 PINTLE HOOK
- 16 HAND VALVE

Figure 3-4. M26-A1 Prime Mover Attachment to S-IC Transporter (Sheet 2 of 2)

3-12. M26-A1 PRIME MOVER COUPLED TO S-1C TRANSPORTER CHECKOUT. Checkout the combined transporter and prime mover per figure 3-5 as follows:

- a. Perform all requirements of paragraphs 3-6 through 3-11.
- b. Inspect each air line from prime mover to transporter for damage or leakage.
- c. Check air pressure gage on each of the three transporter reservoirs for 103 (± 22) psig per figure 3-3.
- d. Drain condensate from the three reservoirs by momentarily opening the drain valves per figure 3-3.
- e. Apply and release brakes several times on prime mover and front and rear dollies. Do not apply all brakes at the same time per figure 3-1 and figure 3-5.
- f. Inspect all electrical cables for damage. Check that connectors are secure.

NOTE:
SEE FIGURE 3-3
FOR LOCATIONS

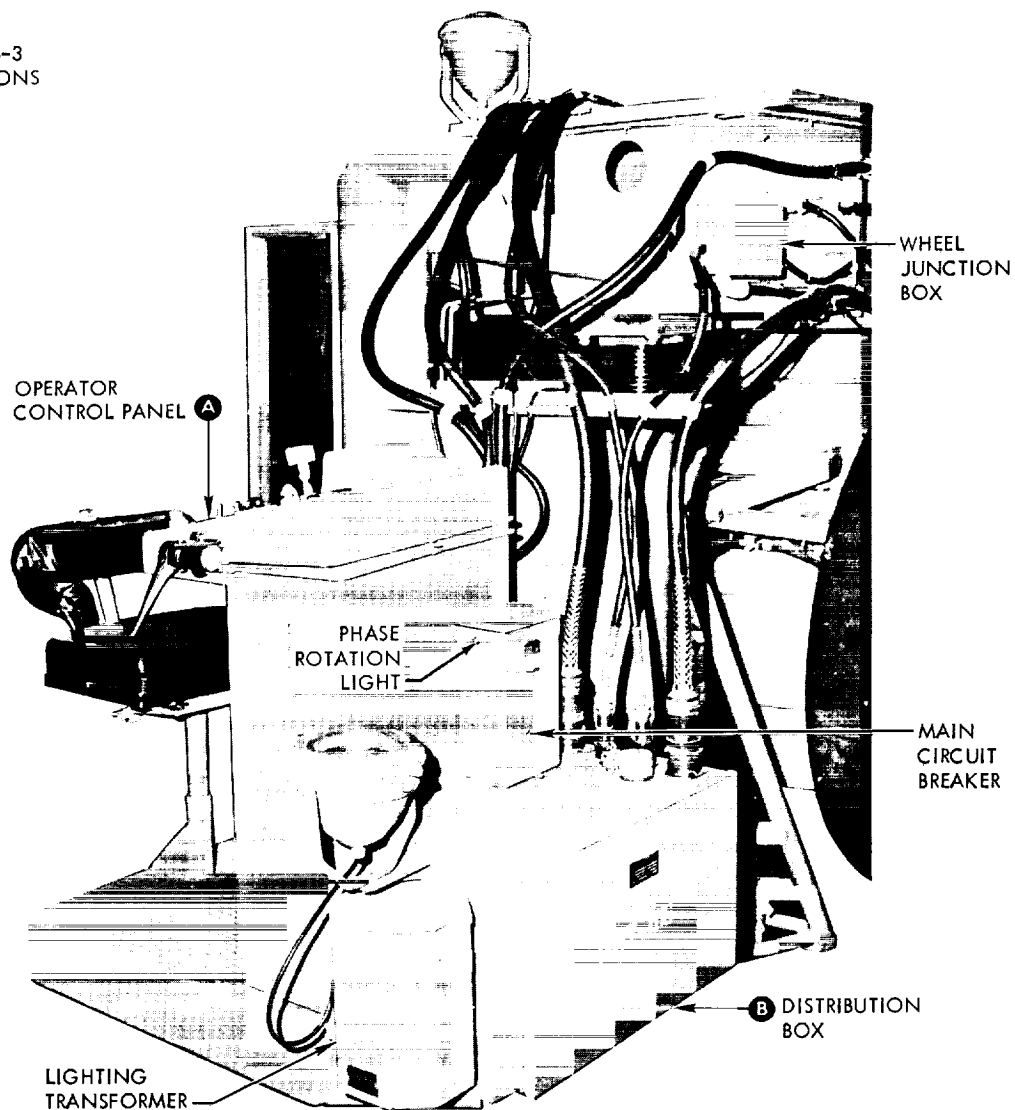


Figure 3-5. Operators Console (Sheet 1 of 2)

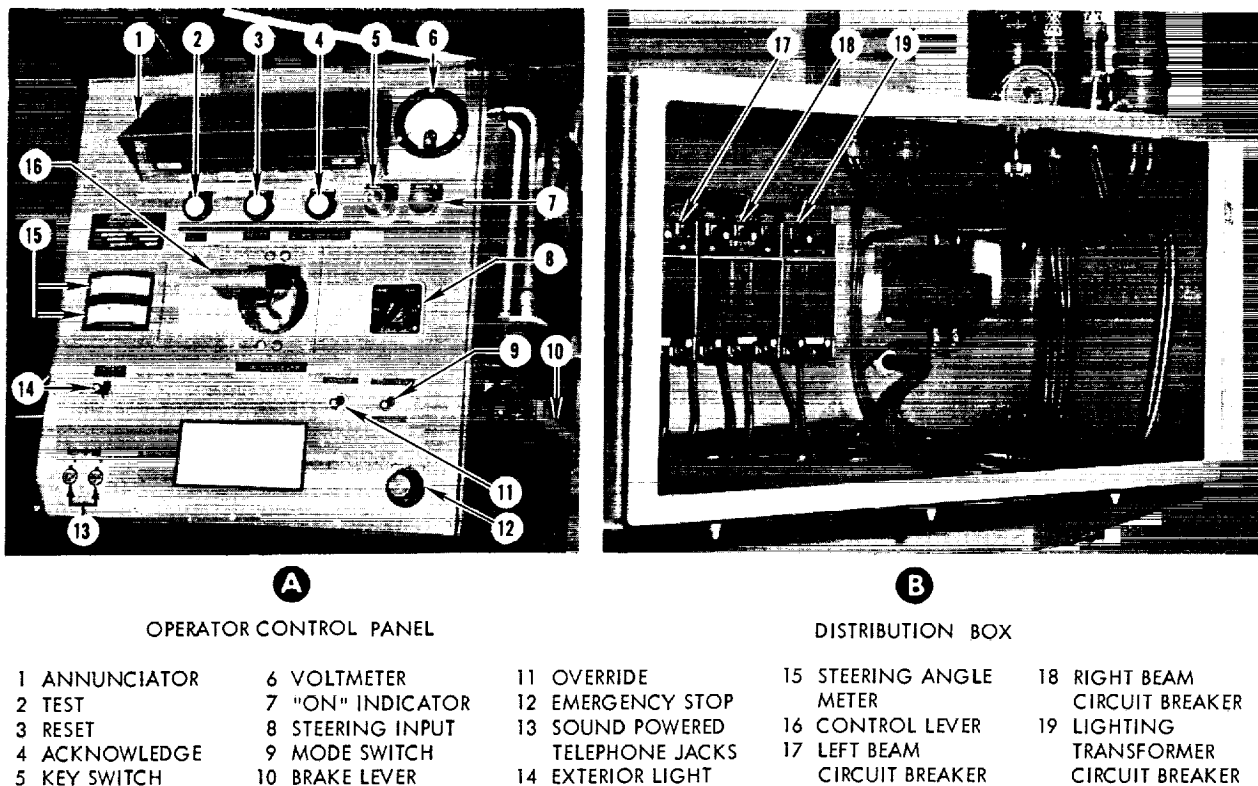


Figure 3-5. Operators Console (Sheet 2 of 2)

- g. Check transporter wheels for turning clearance.
- h. Place main circuit breakers and right and left beam switches in distribution box at both consoles to OFF.
- i. Perform prestart checkout, and start the Onan generator per paragraph 3-9.

NOTE

Steps j, k and l are applicable to the forward towed dolly only.

- j. Check phase rotation light on main circuit breaker at operators console. Light must be ON, otherwise phase rotation is incorrect or other malfunction is present.
- k. Place main circuit breaker on forward operators console to ON.
- l. Observe voltmeter on forward operator control panel for 470 (+10) vac.
- m. Check sound powered intercommunication system between prime mover, front console and rear console operators
- n. Set mode switch on both console panels to ACKERMANN.
- o. Set both STEERING INPUT switches to IND.
- p. Set both STEERING RATE switches to No. 4 (1/2° per second) on units Serial No. 101, 102 and 103 (located between (14) and (15)).
- q. Position key switches on both panels to ON.

NOTE

Horn will sound and some of the red lights on annunciator may come on. Press ACKNOWLEDGE button to squelch horn. Press RESET button when wheel steering action stops. All red lights should go out. If red lights do not go out, turn key switch to OFF and determine cause of malfunction.

- r. Press TEST button, verify horn sounds and all lights illuminate.

NOTE

Press ACKNOWLEDGE and RESET buttons to silence horn and turn off lights.



Except in extreme cases all steering is to be done by one operator only.

- s. On both consoles observe the ACKERMANN (A) - PARALLEL (P) lights on annunciator. If Ackermann light (A) is not ON, the parallel (P) light should be ON. This indicates that the steering system is not zeroed. NOT ZERO light should be ON and Ackermann to parallel switching cannot occur. Move the steering control lever in proper direction until steering angle meter reads zero. At this time, the parallel and NOT ZERO lights should go out and the Ackermann (A) light should come on.
- t. Move front dolly steering control lever in either direction and observe steering angle meter and wheel units for proper operation. Return to zero position on steering angle meter.
- u. Repeat step "t" for rear dolly.
- v. Switch steering input switches on both consoles to FRONT. Repeat step "t" for front dolly.
- w. Switch steering input switches on both consoles to REAR. Repeat step "t" for rear dolly.
- x. Set mode switch to PARALLEL.
- y. Repeat steps "t" through "w".
- z. Repeat steps "t" through "y" using steering rate No. 3 (1° per second), No. 2 (1 1/2° per second) and No. 1 (3° per second) on both consoles.
- aa. Steering system is now ready for operation.
- ab. Check the lowering and raising action of the transporter by operating levers on the Hydraulic Control packages per figure 3-6.

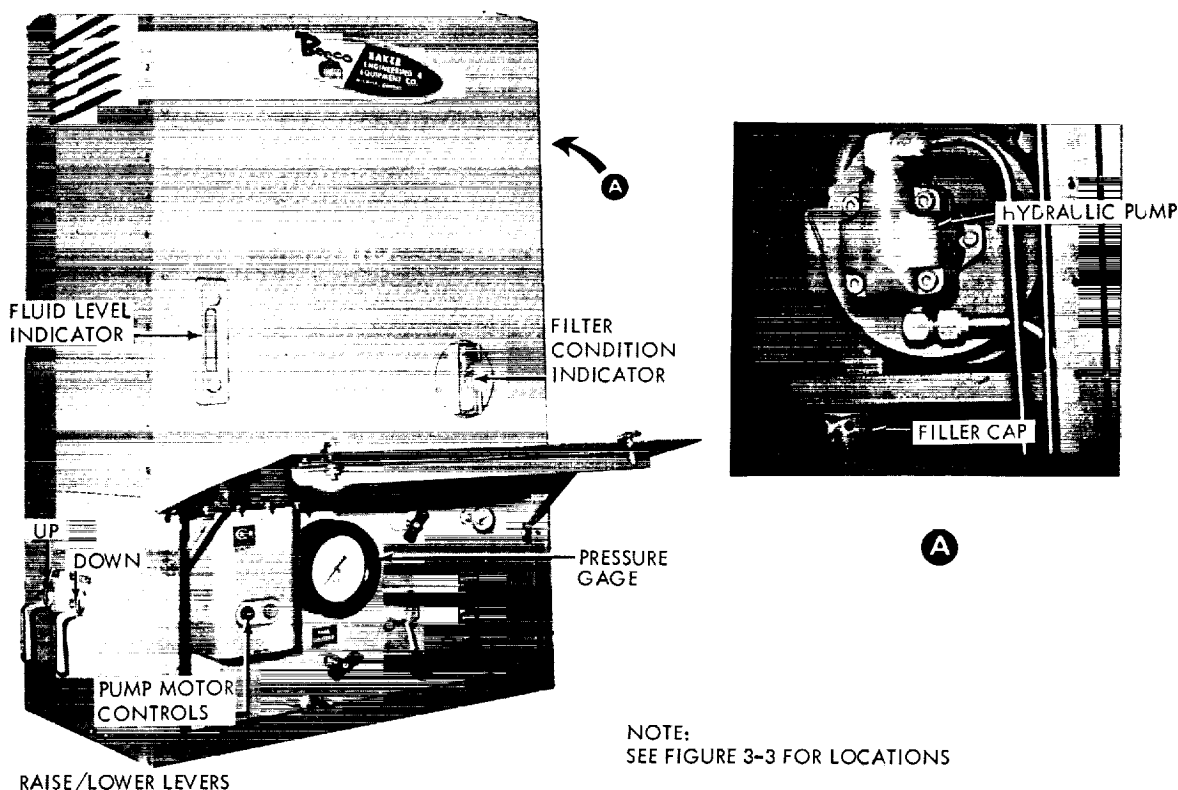


Figure 3-6. Hydraulic Control Package (Front Dolly)

3-13. PROPELLANT TANK PRESSURE AND CONTROL UNIT - CHECKOUT. Conduct tests to propellant tank pressure and control unit (65B64146-1) per figure 3-7 as follows:

CAUTION

Assure that all fittings are LOX clean and gas complies to MSFC-SPEC-164.

- a. Begin checkout of LOX pressure control module (65B64147-1).
- b. Disconnect 150 PSIG INPUT hose from GAS INPUT fitting (19) on the RP-1 module and cap module connection with (31) and plug 150 PSIG INPUT hose.
- c. Disconnect the TANK SUPPLY hose from fitting (15) on the LOX module and plug hose.

CAUTION

The TANK SUPPLY hose will be pressurized at approximately 3 psig due to tank internal pressure.

- d. Power control unit with 115 (+ 10) volts ac at jack (20) and connect Portable Pneumatic Calibration Unit (PPCU) (see figure 2-1) to the TANK SUPPLY fitting (15).
- e. Verify POWER ON (4) light is illuminated, then press PRESS TO TEST HORN AND LIGHTS switch and verify the following lights are illuminated and horn sounds:

- (1) Warning horn (18)

NOTE

Upon verification of horn press HORN SILENCE switch (17) to silence horn.

- (2) TANK PRESSURE BELOW NORMAL (5) light.
- (3) FILTER ELEMENT DIRTY (6) light.
- (4) AUXILIARY GAS BEING USED (7) light.
- (5) WARNING (8) light.
- f. Install 30 psig master gage on the PPCU.
- g. Place two-way valve (1) per figure 3-7 in the FACILITY GAS SUPPLY position.
- h. Place 3-position -4 way control valve (13) in the AUTOMATIC REGULATE position and slowly open one cylinder valve (30) apply pressure from 75 psig min. to 160 psig max. to module 150 PSIG INPUT (19).
- i. Verify 150 (± 10) psig on (2) SUPPLY PRESSURE gage.
- j. Verify 3.00 (± 0.75) psig output on master gage.
- k. Place 3 position - 4 way control valve (13) in the 20 PSIG FILL position.
- l. Verify 20.0 (± 2.0) psig output pressure.

CAUTION

When testing vacuum relief valve (65B64142-3) use clean gas supply only.

- m. Remove electrical power from test module by pulling circuit breaker plunger (9).
- n. Close cylinder valve (30) and slowly depressurize system by placing 3 position - 4 way valve (13) in MANUAL RELIEF position. Manually verify that the NEGATIVE RELIEF VALVE is open to atmosphere when master gage reading is 0.10 \pm 0.03 psig.
- o. Place 3 position - 4 way valve (13) in 20 PSIG FILL position and slowly open one cylinder valve (30), apply pressure to 0.50 psig maximum and verify NEGATIVE RELIEF VALVE is closed.
- p. Place 3 position - 4 way valve (13) in the AUTOMATIC REGULATE position and apply pressure from 75 psig min., to 160 psig max. to module GAS INPUT (19).
- q. Slowly pressurize TANK SUPPLY fitting (15) utilizing PPCU until 6.5 psig is attained.

CAUTION

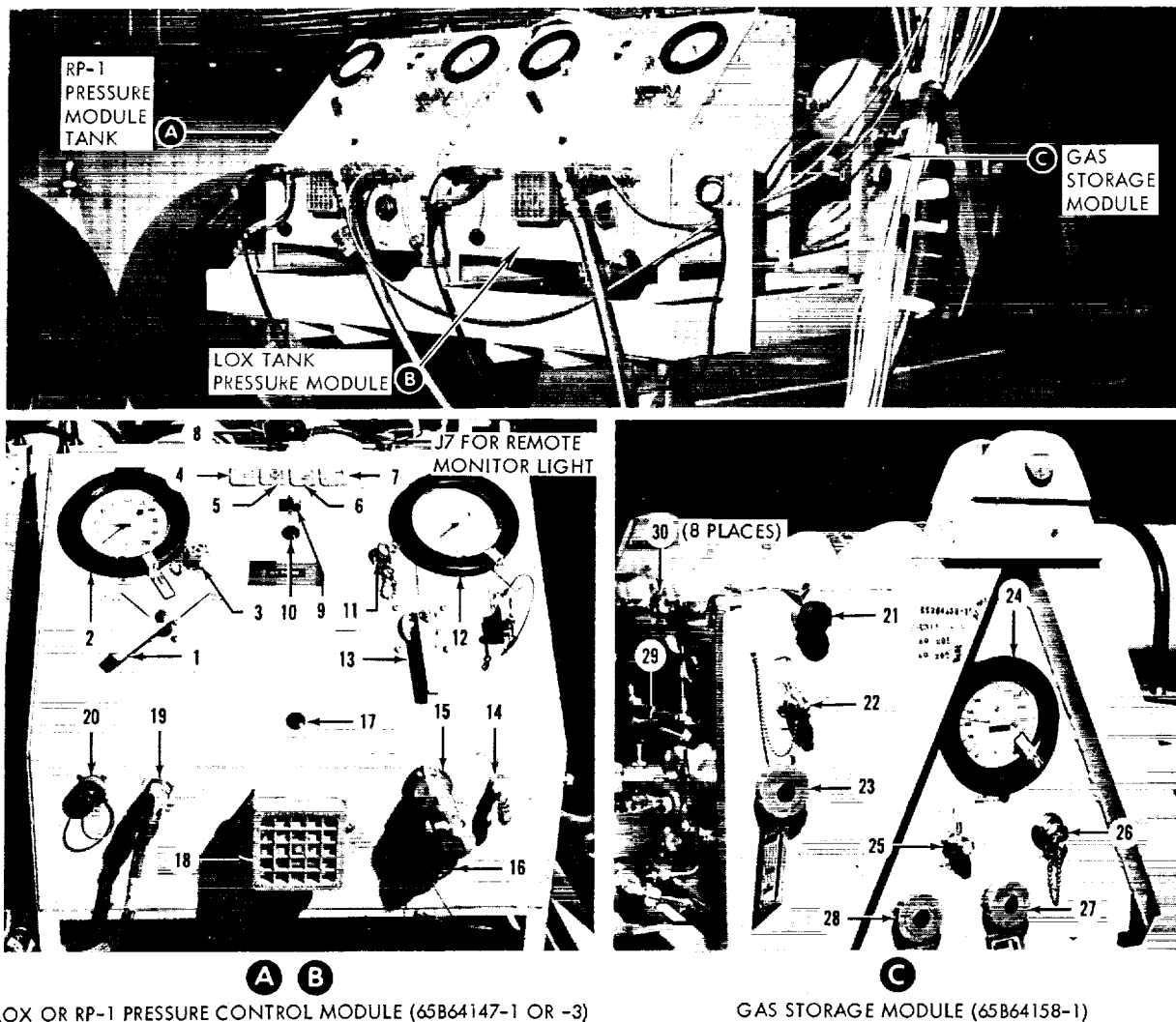
Do not exceed 7.5 psig.

- r. Verify that the low pressure relief valve 65B23309-15, located in the module adjacent to valve (13) opens at pressure of 5.00 ($\pm .25$) psig.
- s. Decrease pressure and verify that low pressure relief valve reseats by 3.75 psig.

WARNING

The TANK SUPPLY hose will be pressurized to approximately 3 psig due to tank internal pressure.

- t. Depressurize system and disconnect PPCU. Reconnect TANK SUPPLY hose to module fitting (15).



LOX OR RP-1 PRESSURE CONTROL MODULE (65B64147-1 OR -3)

GAS STORAGE MODULE (65B64158-1)

- | | | |
|-------------------------------|-----------------------------|--------------------------------------|
| 1 SUPPLY PRESSURE VALVE | 11 TANK PRESSURE CAL. VALVE | 21 VALVE, MANUAL RELIEF |
| 2 SUPPLY PRESSURE GAGE | 12 TANK PRESSURE GAGE | 22 FITTING, CYLINDER FILL |
| 3 SUPPLY PRESSURE CAL. VALVE | 13 TANK PRESSURE VALVE | 23 VALVE, SYSTEM SHUTOFF |
| 4 LIGHT, POWER ON | 14 FITTING, TANK SENSING | 24 GAGE, CYLINDER PRESSURE |
| 5 LIGHT, T.P. BELOW NORMAL | 15 FITTING, TANK SUPPLY | 25 FITTING, 150 PSIG FACILITY SUPPLY |
| 6 LIGHT, DIRTY FILTER | 16 NEGATIVE RELIEF VALVE | 26 FITTING, GAGE CALIBRATION |
| 7 LIGHT, AUX. GAS SUPPLY | 17 SWITCH, HORN SILENCE | 27 VALVE, MANIFOLD SHUTOFF |
| 8 LIGHT, FLASHING RED | 18 HORN | 28 VALVE, CYLINDER FILL |
| 9 CIRCUIT BREAKER PLUNGER | 19 FITTING, GAS INPUT | 29 VALVE, PRESSURE REGULATOR |
| 10 SWITCH, HORN & LIGHTS TEST | 20 JACK, POWER INPUT | 30 VALVE, CYLINDER (8 PLACES) |
| | | 31 CAP ASSEMBLY-AN 929-8K |

Figure 3-7. Propellant Tank Pressure and Control Unit

- u. Remove electrical power from test module by pulling circuit breaker plunger (CB1) (9), Disconnect TANK SENSE hose from fitting (14), and plug hose.
- v. Connect PPCU to TANK SENSE fitting (14) and pressurize to approximately 3.0 psig. Depress circuit breaker plunger (9) to restore electrical power.
- w. Slowly pressurize to 6.0 psig.
- x. Verify that at 5.0 (\pm , 1) psig an increase of pressure causes the RED FLASHING WARNING LIGHT (8) to flash ON and warning horn (18) to sound.

NOTE

Upon verification of horn, press HORN SILENCE switch (17) to silence horn.

- y. Slowly decrease pressure and verify the red flashing warning light (8) is off by 4.4 psig and TANK PRESSURE BELOW NORMAL LIGHT, AMBER (5) is on at 1.4 (\pm , 1) psig.
- z. Decrease pressure further and verify that at 0.6 (\pm , 1) psig the AUXILIARY GAS IS BEING USED LIGHT, GREEN (7) is on.
- aa. Slowly increase pressure and verify at 1.0 psig that the AUXILIARY GAS IS BEING USED LIGHT (7) is OFF.
- ab. Slowly increase pressure and verify TANK PRESSURE BELOW NORMAL LIGHT (5) is OFF at 2.0 psig.
- ac. Depressurize system, disconnect PPCU, and reconnect TANK SENSE hose on fitting (14).
- ad. Disconnect 150 PSIG INPUT hose from GAS INPUT fitting (19) and plug hose.
- ae. Connect PPCU to module GAS INPUT fitting (19).
- af. Place 2-way valve (1) in AUXILIARY GAS SUPPLY position and raise pressure to 220 psig.
- ag. Verify that high pressure relief valve (65B23309-5) located within the module attached to the GAS INPUT fitting (19), opens at 200 (\pm , 10) psig.
- ah. Decrease pressure and verify the high pressure relief valve reseats by 170 psig.
- ai. Depressurize and disconnect PPCU and cap GAS INPUT fitting (19).
- aj. Begin checkout of RP-1 pressure control module (65B64147-3).
- ak. Perform steps "ae" through "ah".
- al. Depressurize and disconnect PPCU and connect GAS INPUT hose to fitting (19).
- am. Disconnect TANK SUPPLY hose from fitting (15) and plug hose.

WARNING

The TANK SUPPLY hose is pressurized to approximately 3.0 psig due to tank internal pressure.

- an. Perform steps "d" through "ac" on RP-1 module.
- ao. Restore Pressure and Monitor System to pre-test configuration.
- ap. Begin checkout of Gas Storage Module Assembly (65B64158-1).

CAUTION

Do not apply more than 1800 PSIG maximum pressure to (29) regulator (65B64139-5).

- aq. Place the facility GN₂ supply (25) to OFF.
- ar. CLOSE the eight GN₂ cylinder shutoff valves (30).
- as. OPEN the MANIFOLD SHUTOFF valve (27).
- at. CLOSE the CYLINDER FILL valve (28).
- au. OPEN the SYSTEM SHUTOFF valve (23).
- av. Disconnect 150 PSIG INPUT hose from GAS INPUT fitting (19) and on LOX and RP-1 pressure control module cap fitting with (31).
- aw. Connect 150 PSIG INPUT hose to PPCU and attach 300 psig master gage.
- ax. Place RP-1 module 2-position valve (1) in the AUXILIARY GAS position.
- ay. Slowly open one gas cylinder valve (30) until approximately 1750(+50) psig is indicated by cylinder pressure gage (24). Verify 150 (+10) psig on the PPCU master pressure gage.
- az. Close gas cylinder valve (30).
- ba. Open the CYLINDER FILL valve (28).
- bb. Open the MANUAL RELIEF valve (21) and depressurize system.
- bc. Depressurize and disconnect PPCU.
- bd. Remove relief valve (32) (65B23309-13) located behind control panel below CALIBRATION valve (26).
- be. Test relief valve on a test bench to verify that the valve opens at 3900 (± 100) psig.

CAUTION

Do not allow relief valve (65B23309-13) to be subjected to back pressure exceeding 200 psid.

- bf. Slowly depressurize the valve to 3300 (± 100) psig and verify relief valve reseal by 3500 psig minimum.
- bg. Vent pressure, remove relief valve from test bench.
- bh. Reinstall relief valve in Gas Storage Module Assembly (65B64158-1).
- bi. Close the MANIFOLD SHUTOFF (27) valve.
- bj. Ensure that all CYLINDER FILL (30) valves are closed.
- bk. Calibrate the Gas Storage Module pressure gage utilizing PPCU and pressurize the Gas Cylinder Pressure Gage (24) thru GAGE CALIBRATION fitting (26) in increments per figure 3-8.
- bl. At each discrete PPCU input level verify that the gage readout indicates the pressure in figure 3-8.
- bm. Depressurize and disconnect PPCU.
- bn. Open the MANUAL RELIEF valve (21), then MANIFOLD SHUTOFF (27) valve and depressurize system.

- bo. Close the MANUAL RELIEF (21) valve and reconnect 150 PSIG INPUT hose to GAS INPUT fitting (19) LOX and RP-1 PRESSURE CONTROL MODULE.
- bp. Begin calibration of LOX pressure control module pressure gages utilize the PPCU and the master gages per figure 3-8.



Do not exceed full scale on any pressure gage.

- bq. Pressurize the supply pressure gage per figure 3-7 (2) and the TANK SENSE PRESSURE GAGE (12) through calibration fittings (3) and (11) respectively to pressure increments given in figure 3-8.
- br. At each discrete PPCU input, verify that the gage readout indicates the pressure in figure 3-8.
- bs. Calibrate the RP-1 pressure control module pressure gages by repeating steps "bp" through "br" for RP-1 module pressure gages.

GAGE NOMENCLATURE	RANGE (PSI)	REFERENCE	MASTER GAGE (PSI)	PPCU PRESSURE (PSI)	REQUIRED GAGE READING
(LOX MODULE) SUPPLY PRESSURE	0 - 200	(2)	0 - 300	5 60 105 150 200 0	0 (+ 4) 60 (+ 4) 105 (+ 4) 150 (+ 4) 200 (+ 4) 0 (+ 4)
(LOX TANK) SENSE PRESSURE	0 - 10	(12)	0 - 30	0 2.25 4.50 6.75 10.00 0	0 (+ 1.00) 2.25 (+ 1.00) 4.50 (+ 1.00) 6.75 (+ 1.00) 10.00 (+ 1.00) 0 (+ 1.00)
(FUEL TANK MODULE) SUPPLY PRESSURE	0 - 200	(2)	0 - 300	0 60 105 150 200 0	0 (+ 4) 60 (+ 4) 105 (+ 4) 150 (+ 4) 200 (+ 4) 0 (+ 4)
(FUEL TANK) SENSE PRESSURE	0 - 10	(12)	0 - 30	0 2.25 4.50 6.75 10.00 0	0 (+ 1.00) 2.25 (+ 1.00) 4.50 (+ 1.00) 6.75 (+ 1.00) 10.00 (+ 1.00) 0 (+ 1.00)
GAS CYLINDER PRESSURE	0 - 6000	(24)	0 - 6000	0 1500 3000 4000 4500 0	0 (+ 100) 1500 (+ 100) 3000 (+ 100) 4000 (+ 100) 4500 (+ 100) 0 (+ 100)

Figure 3-8. Pressure Gage Calibration Requirements

3-14. TRANSPORTER DATA RECORDING EQUIPMENT CHECKOUT. Checkout recorder equipment per figure 3-9 as follows:

a. Set control panel switches as follows:

- | | |
|-----------------------------|--------------|
| 1. ACCEL SELECTOR | LOW |
| 2. HUMID/PRESS | PRESS |
| 3. AC POWER | OFF (down) |
| 4. CHARGE ONLY-STBY-OPERATE | STBY |
| 5. START AUTO-RESTART | OFF (center) |

b. Inspect power cable (4013369-1) after battery leads have been insulated with tape and tied along power cable with tape.

WARNING

Battery cable leads are charged at approximately 36 volts while recorder unit is operating on ac power.

- c. Connect the power cable (4013369-1 or 4013362-1) from recorder connector J-101 to insulation transformer Solar 23-22-125.
- d. Plug transformer into 115 vac power source and place transformer switch to ON position.
- e. Set the control panel ac power switch to ON and verify that the ac power indicator light is ON.
- f. Set the ac power switch to OFF and verify that the indicator goes out.
- g. Connect the cables between the sensor modules and the recorder as per figure 3-9, detail A.

NOTE

Shorting plugs may be substituted for any or all cables and modules for operational verification only. Final calibration and checkout requires all modules and cables to be connected.

h. Set the control panel switches to the following positions per figure 3-9.

- | | |
|---------------------|-------|
| ACCEL. SELECTOR | HIGH |
| HUMID/PRESS | PRESS |
| AC POWER | OFF |
| CHARGE-STBY-OPERATE | STBY |
| START AUTO-RESET | OFF |

- i. Verify the external power cable (4013369-1) to recorder connector J-101 is connected to 115 vac power source per step "b".
- j. Set the AC POWER switch ON and verify the AC POWER ON indicator illumination.
- k. Allow 30 minutes for warm-up and stabilization.
- l. Verify the following voltages with a Fluke differential voltmeter, at the control panel test points:

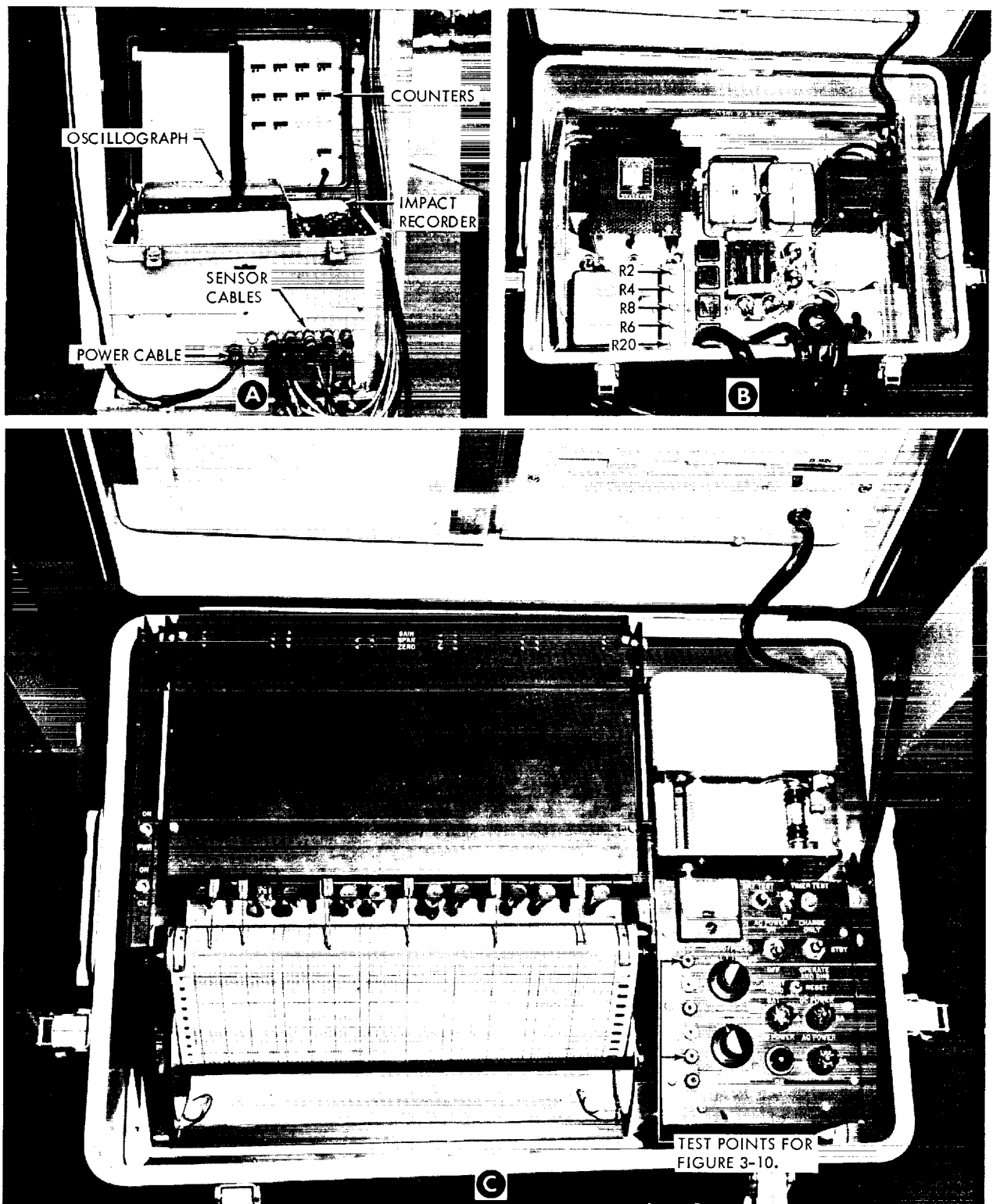


Figure 3-9. Transporter Data Recording Equipment Checkout

TEST POINT	REV. A	REV. B
TS 6	+1.000 (\pm .001) V*	+1.000 (\pm .001) V*
TS 2	+27 (\pm .5)V	+27 (\pm .5)V
TS 3	-2.5 (\pm 0.002)V	-0.70 (\pm 0.010)V
TS 4	+15 (\pm 0.005)V	+15 (\pm 0.1)V
TS 5	-15 (\pm 0.005)V	-15 (\pm 0.1)V
* This value is a critical calibration voltage. For adjustment, use R-20.		

Figure 3-10 Data Recorder - Checkout Voltages

NOTE

The easily identifiable difference between revisions A and B are the markings at TS 3. Revision A is - 0.7 V.
Revision B is - 2.5 V.

- m. Place the ZERO/F.S. switch in the ZERO position to energize the zero calibration circuits, per figure 3-9, details B and C.
- n. Set the CHARGE-STBY-OPERATE switch to OPERATE.
- o. Set the START AUTO-RESET switch to START AUTO.

NOTE

The oscillograph pens may not move into alignment with the calibrated lines on the chart paper.



Do not attempt to manually position the pens at any time.

- p. Turn the oscillograph switches at the top left side of the oscillograph to ON.
- q. Measure the zero calibrate voltage at the input test point for channel 1 of the oscillograph. If necessary, adjust the channel 1 zero adjust potentiometer to obtain 0.0000 volts per figure 3-9, detail C.
- r. Repeat the zero calibrate voltage measurement for oscillograph channels 2, 3, and 4.
- s. Verify that the oscillograph pens write on the chart zero lines for all channels. If not, adjust the pen ZERO potentiometers to align the pen traces with the zero lines.
- t. Place the ZERO/F.S. switch in the F.S. position to energize the full-scale calibrate circuits.
- u. Measure the full-scale calibrate voltage at the input test point for channel 1 of the oscillograph. If necessary adjust the channel 1 F.S. adjust potentiometer (R 17) to obtain 1.000 volts- Rev. A or 0.62 volts- Rev. B.
- v. Repeat the full-scale calibrate voltage measurement for oscillograph channels 2, 3, and 4. Adjust potentiometer R 18, R 19 on R 20 to obtain required volts.
- w. Verify that the oscillograph pens write on the chart full-scale lines for all channels. If not, adjust the pen SPAN potentiometers to align the pen traces with the full-scale lines.
- x. Set the HUMID/PRESS switch to HUMID.

- y. Adjust the humidity channels to full-scale, using the pen SPAN adjustments on the oscillograph.
- z. Set the HUMID/PRESS switch to PRESS.
- aa. Measure the voltage at the input test point for channel 5 and 6 on the oscillograph. If necessary, adjust potentiometers R2 and R4 to obtain 1.000 volts inputs, which should align the pen traces with the chart full-scale lines. Remove oscillograph from case per figure 3-9, detail B.
- ab. Measure the voltage at the input test points for channels 9 and 10. If necessary, adjust R8 and R6, respectively, to obtain 1.000 volt input. Adjust the pen SPAN potentiometers for channels 9 and 10 to align pen traces with the chart full-scale lines.
- ac. Set ZERO/F.S. switch to center position.
- ad. Set the oscillograph channel GAIN controls for optimum performance.

NOTE

Adjust each channel GAIN potentiometer counter clockwise until the pen becomes active, then slowly decrease to reduce the activity. Slight activity is desirable and produces maximum accuracy.

- ae. Zero all the counters in the record case cover by depressing the reset button just below each counter dial per detail A.

NOTE

The time counter and chart transport may advance one position if the timer is at the 15-minute timing interval when power is applied to the recorder circuits. If this occurs, the affected counters should be reset and a notation made on the chart.

- af. Verify the proper operation of the recording functions as follows:
 - (1) Select an accelerometer module and determine the corresponding counter by noting the color code and setting of the ACCEL. SELECTOR switch.

NOTE

The switch should be set to HIGH or LOW, depending on the range being tested (0.25 to 0.75 g, or 0.5 to 1.0 g).

- (2) Gently tilt the module by hand in the specified horizontal and vertical planes, and verify that the acceleration switches activate at approximately the tilt angles per figure 3-11:

FORCE (g)	TILT ANGLE IN DEGREES	
	HORIZONTAL	VERTICAL
.25	14.5	41.5
.50	30.0	60.0
.75	48.5	75.5
1.00	90.0	90.0

Figure 3-11 Data Recorder - Accelerometer Checkout

- (3) Repeat the above steps for each remaining acceleration module.

NOTE

Two of the modules have both horizontal and vertical accelerometers, and one module has horizontal accelerometers only.

- (4) Change setting of ACCELEROMETER SELECTOR switch and repeat above procedure.
 - (5) Press and release TIMER TEST button on control panel. This should cause timer counter to register one count, chart paper to be marked at timer track, and chart transport to advance one step.
 - (6) With power applied to recorder, note exact time when timer counter advances, timer channel of chart is marked, and chart advances for the first time.
 - (7) Note exact time when above actions occur for second time. Time interval between first and second events should be approximately 15 minutes.
 - (8) Press TIMER TEST switch, hold down for approximately 30 seconds, and verify that the zero and full-scale calibrations are marked.
 - (9) Tilt pitch and roll module both laterally and longitudinally. The movement of the two pens on the pitch and roll channels of the oscillographic recorder should reflect the attitude of the module. Zero and full-scale deflections of the pens should occur with the module tilted -15° and $+15^{\circ}$ respectively in the pitch direction and -25° and $+25^{\circ}$ respectively in the roll direction.
 - (10) Remove cover and four screws and hold hand over cover area of temperature/humidity modules. The pens on the corresponding recorder channels should deflect.
- ag. Verify that pen pressure against paper is light, just sufficient to insure that pen contacts paper across its entire travel. Pen arms are stainless steel and may be bent slightly to adjust pen pressure. Too-light pressure is indicated by skipping of the trace. Pressure is too heavy if it is observed that pen digs into paper and tilts away from vertical when pen is slewing and while chart is in motion.
- ah. Fill ink wells with an eyedropper. Fill reservoir while pressing eyedropper into vent very lightly so as to allow air to escape. Reservoir should be filled nearly to the top. Then, with an empty eyedropper, press it firmly in the vent and squeeze, so that air pressure will force ink into pen. Should air bubbles be observed in ink hose place a small piece of absorbent paper under pen tip to absorb excess, and continue forcing ink through the system until bubbles are gone. It is necessary to use two different colors of ink so that the two traces on the same section of chart can be easily identified. It is suggested that the right reservoir of each channel be filled with blue ink, and the left reservoir, with red ink. Pens usually clog at the tip only if the recorder has been standing idle with ink in the system. Fine cleaning wires are obtainable, and a pen can usually be restored to service merely by inserting cleaning wire into tip 1/8 inch or so. This can generally be done without removing the pen. Should a pen be badly clogged, it may be necessary to remove it, ream it out with cleaning wire, and then force water or preferably alcohol through it.
- ai. Replace oscillograph chart paper with 250 foot new roll (Lockheed 4013381-1) per figure 3-9 as follows:
- (1) Release catches on takeup roll and lift out roll.
 - (2) Remove rolled chart from takeup roll by unscrewing right end plate, then slide spool out of roll chart to the left.
 - (3) Release catches on supply roll and slide roll forward out of oscillograph.
 - (4) If part of chart is still on supply roll, push drive roll to the left to disengage drive, then rotate toward front of oscillograph to feed chart through drive roll and onto takeup roll.
 - (5) To install chart, slide supply roll hub into chart roll and insert supply roll into catches. Cut or fold in the corners of chart to make chart end triangular. Feed triangular end under guide support bar, then over the drive roll and onto the takeup roll (release and rotate the drive roll as necessary to engage holes in chart with drive roll sprockets). Insert the takeup roll into the catches and secure them. Rotate the drive roll and takeup roll as necessary to ensure chart is aligned and without slack, and tape chart end to takeup core.
- aj. Replace the impact recorder chart roll with a full 150 foot roll as follows per figure 3-9 if the supply is less than 1/4 of a roll.

- (1) Remove chart transport unit from recorder by unscrewing four screws and unplugging cable from chassis.
- (2) Remove knurled screw, and slip off plate supporting outer end of spool shafts. Release spool to be removed by pulling on extended-shaft knob and shifting reel toward the relieved side.
- (3) Pressure roller must be lifted if chart paper is to be pulled through by hand. If a small amount of chart paper is to be advanced, this can be accomplished by hand-rotating the upper drive gearing.
- (4) To insert a new chart roll, feed chart paper under marking pens and index overlay, lift pressure roller and feed chart paper behind frame spacer. Attach chart paper to takeup reel slot on inner edge where it can engage drive pin.
- (5) Wind excess paper onto takeup reel with marking surface on the outside. Insert in transport unit. Be sure that drive pins are in reel slots. Replace support plate and knurled screw.
- (6) Check gear and pulley setscrews for tightness.

ak. Replace chart transport unit.

al. Verify operation of both charts by operating recorder for five minutes.

3-15. PRIME MOVER AND S-IC TRANSPORTER SHUTDOWN. Upon completion of checkout or operation shutdown equipment as follows:

- a. Place switches on S-IC tank monitor equipment to OFF.
- b. Place data recording equipment switches to OFF.
- c. Actuate right and left beam switches to OFF position in the breaker box on the front and rear consoles.
- d. Turn key switches on both consoles to OFF position.
- e. Actuate circuit breakers on both consoles to OFF.
- f. Cover consoles with covers.
- g. Cover console seats with covers.
- h. Actuate main circuit breaker on diesel generator to OFF.
- i. Turn toggle switch of diesel engine that drives generator to OFF.
- j. Disconnect all power, air and communications from prime mover.
- k. Cover all power outlets with dust caps.
- l. Chock transporter wheels.
- m. Remove tow bar from prime mover.
- n. Detach power, air and communication lines from transporter at tow bar connections.
- o. Cover all power outlets with dust caps.
- p. Remove tow bar from transporter.
- q. Return all equipment to storage.
- r. Secure operation.



SECTION IV

S-IC STAGE PREPARATION FOR TRANSPORTATION

4-1. INTRODUCTION.

4-2. This section provides procedures for loading the S-IC stage on the transporter, and installing tank pressure and control equipment, transportation instrumentation, data recorder and environment covers.

CAUTION

Any time the propellant tanks are sealed from the atmosphere in preparation for transportation, each tank shall be pressurized with GN₂ to a pressure not exceeding 5 psig. Tank pressure shall be sustained to not less than 1.0 psig at all times when the tanks are sealed from the atmosphere. The required positive pressures shall be sustained by facility supplied gas or by GN₂ compressed gas cylinder replenishment supplies and controlled by tank pressure and control modules 65B64147-1 and 65B64147-3.

4-3. S-IC STAGE HANDLING FITTINGS - INSTALLATION. The S-IC stage is equipped with a forward handling tool and handling fittings at stations 248.000 and 115.000 at time of manufacture. They remain in place until the S-IC stage is erected on the mobile launcher at KSC and are removed per technical manual MSFC-MAN-035. Auxiliary handling equipment to load and unload S-IC transporter differ as to location. Where crane service and overhead clearance permits, use the aft rotational brace and forward lifting linkage specified in paragraph 4-4, otherwise use the equipment and procedures required at the MAF per paragraphs 8-3 through 8-7.

NOTE

See technical manual MSFC-MAN-000 for specific vehicle dash number.

4-4. S-IC STAGE AUXILIARY HANDLING FITTINGS - UTILIZATION. Utilize auxiliary handling equipment where crane service and overhead clearance permit per figure 4-1 and 4-2 as follows:

- a. Attach rotation brace upper linkage (75M51009-5) to a 175 ton crane hook at the aft end of S-IC stage. Use previously installed 9 1/2 inch pin (75M51020-1) and pin puller (75M51012-1) per figure 4-1.
- b. Remove pin puller (75M51012-1) and pin retainer clamp assembly (75M51023-4). Install retainer plate (75M51023-8) in pin retainer clamp assembly (75M51023-4) and install pin retainer assembly (75M51023-1).
- c. Hoist rotation brace linkage clear of storage and handling fixture (75M51148) and attach sling (75M51018) and spreader (75M51011) to upper linkage.
- d. Rig sling (75M51018) to rotation brace lower linkage (75M51009-6) by attachment to the single lug (75M51014-1) marked "Horiz. C.G." and install three guide lines for guidance per figure 4-2.

WARNING

All personnel working from suspended scaffolding or platforms, open structures outside of areas protected by handrails, ladders, buildup scaffolding or extendible platforms more than 20 feet above the ground or elevated deck levels, ladders or scaffolding with overturning radii beyond the protection of deck level handrails, or cherry pickers shall wear safety belts. Soft soled shoes and safety belts are mandatory for all personnel working on the S-IC stage.

- e. Hoist rotation brace lower linkage clear of storage and handling fixture (75M51025) to Position III on aft end of the S-IC stage and attach to the three stage handling fittings per figure 4-3. Use previously installed 3 inch pins ((1) 75M51020-5 and (2) 75M51020-6) and pin pullers (75M51012-4). A high ranger and a cherry picker will provide access.
- f. Remove the three pin pullers (75M51012-4) and pin retainer clamp assembly (75M51023-6). Install retainer plate (75M51023-10) in pin retainer clamp assemblies (75M51023-6) and install pin retainer assembly (75M51023-3).
- g. Detach sling (75M51018) from rotation brace lower linkage.
- h. Detach adjustment linkage (75M51013) from rotation brace lower linkage and remove to ground level and stow on pallet or truck.
- i. Remove spreader (75M51011) and sling (75M51018) from rotation brace upper linkage (75M51009-5) and store on pallet or truck.
- j. Connect crane hook with rotation brace upper linkage (75M51009-5) to rotation brace lower linkage (75M51009-6). Use previously installed 4 1/2 inch pin (75M51020-4) and pin puller (75M51012-3)

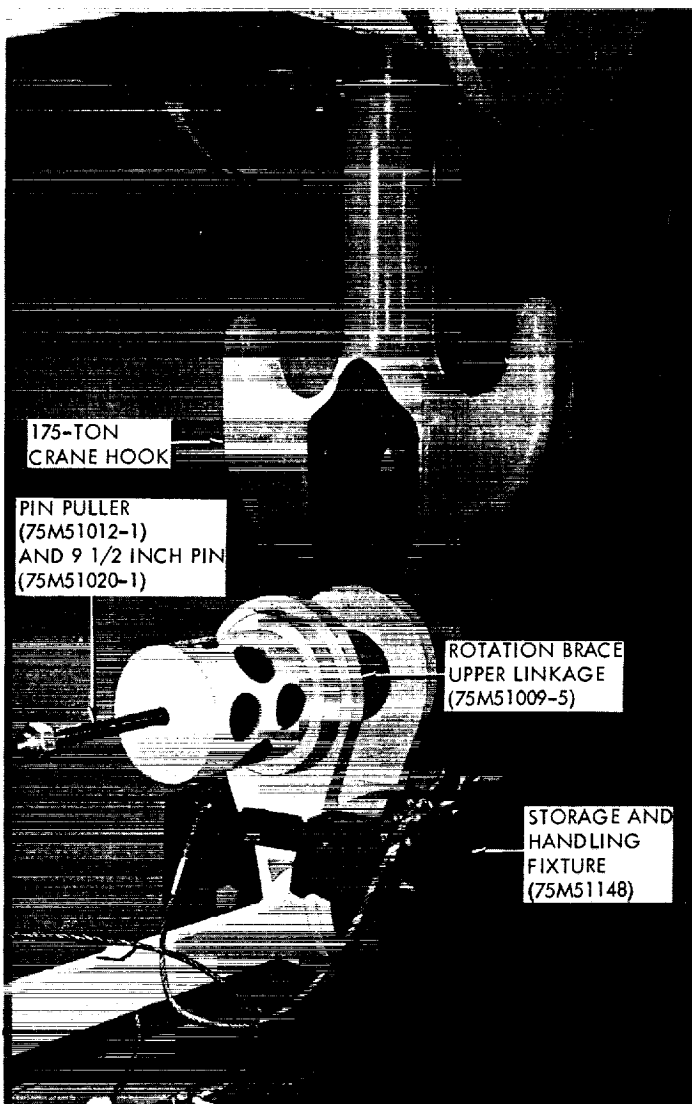


Figure 4-1. Aft Lifting Equipment

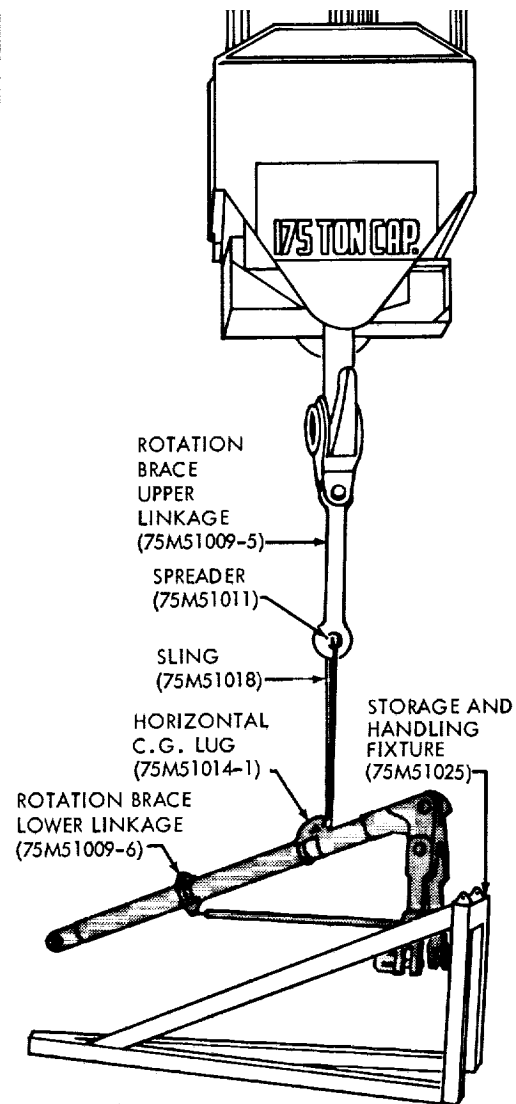


Figure 4-2. Aft Rotational Brace Hoisting

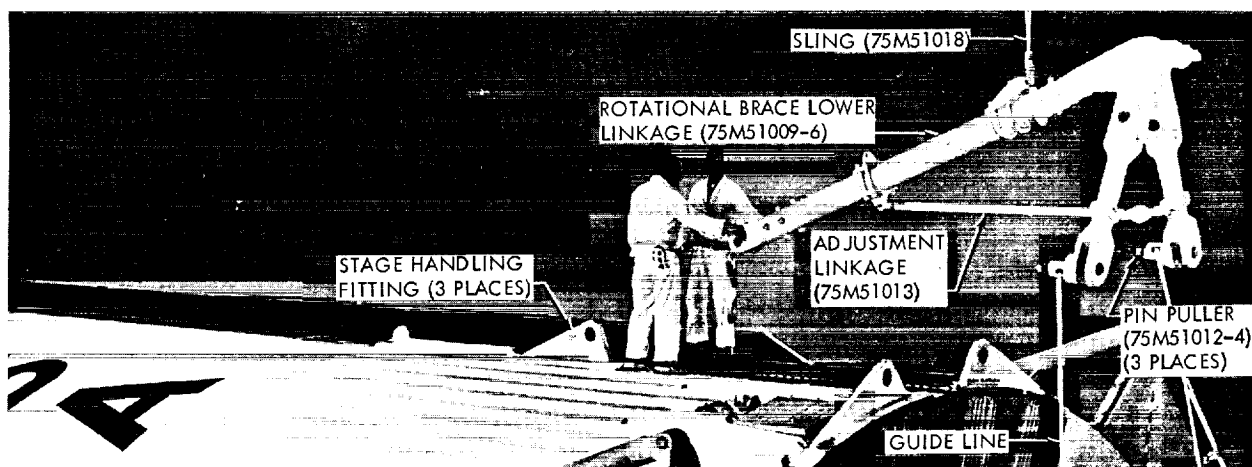


Figure 4-3. Aft Rotational Brace Positioning

- k. Remove the pin puller (75M51012-4) and pin retainer clamp assembly (75M51023-5). Install retainer plate (75M51023-9) in pin retainer clamp assembly (75M51023-5) and install pin retainer (75M51023-2).
- l. Position forward lifting linkage (75M51015) near forward end of S-IC stage.
- m. Attach forward lifting linkage (75M51015) to a 250 ton crane hook at the forward end of S-IC stage per figure 4-4. Use previously installed 9 1/2 inch pin (75M51020-1) and pin puller (75M51012-1).
- n. Remove pin puller (75M51012-1) and pin retainer clamp assembly (75M51023-4). Install retainer plate (75M51023-8) in pin retainer clamp assembly (75M51023-4) and install pin retainer assembly (75M51023-1).
- o. Hoist forward lifting linkage (75M51015) clear of storage and handling fixture (75M51149) and attach to stage forward handling tool. Use the previously installed 5 1/2 inch pin (75M51015-5) and pin puller (75M51012-2). Utilize a forklift with man platform for access.

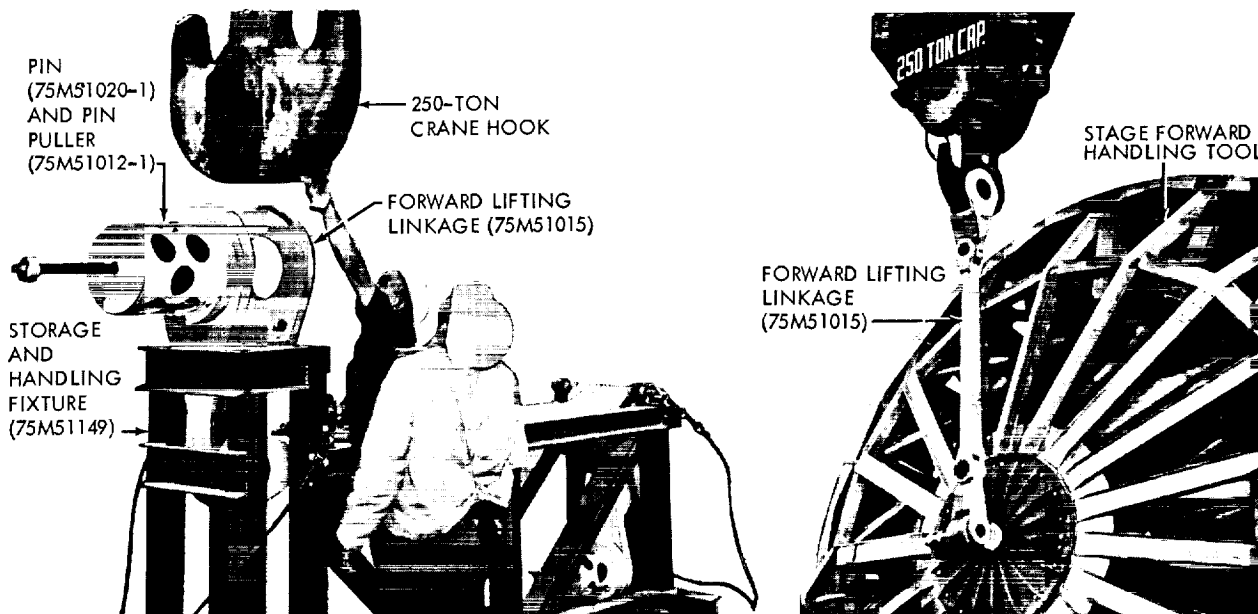


Figure 4-4. Forward Lifting Equipment

- p. Remove the pin puller (75M51012-2) and pin retainer clamp assembly (75M51023-5). Install retainer plate (75M51023-9) in pin retainer clamp assembly (75M51023-5) and install pin retainer assembly (75M51023-2).

4-5. S-IC TRANSPORTER LOADING - GENERAL. Load S-IC stage on the transporter as follows:

- a. Checkout S-IC transporter, prime mover, tank pressure and control equipment, transportation instrumentation and data recorder per paragraphs 3-2 through 3-15.
- b. Verify that the S-IC stage end covers (90M01723-1) and (90M01781-1) are inspected and refurbished as required.
- c. Inspect and verify the installation of environmental covers over openings and equipment on S-IC stage.
- d. Install auxiliary stage handling fittings per paragraph 4-3 where crane service is available. For other locations refer to Section VIII.
- e. Disconnect S-IC tank pressure system and cap fittings on both tanks per paragraph 4-4 in reverse order.
- f. Hoist and position S-IC stage in a horizontal attitude.
- g. Proceed to load front dolly of transporter per paragraph 4-6 and rear dolly per paragraph 4-7 where crane service is available. For other loading methods refer to Section VIII.
- h. Immediately reconnect standby S-IC tank pressure and control units to maintain 3 (+1) psig during installation of tank pressure and control unit per paragraph 4-8.
- i. Install S-IC tank pressurization and control equipment per paragraph 4-8.
- j. Install transportation data recorder per paragraph 4-9.
- k. Verify oscillograph operation per paragraph 4-10.
- l. Install S-IC stage end covers per paragraphs 4-11 and 4-12.

4-6. S-IC TRANSPORTER LOADING (FRONT DOLLY). Load the S-IC stage on the front dolly of the transporter per figure 4-5 as follows:

WARNING

All personnel working on the S-IC stage or from suspended scaffolding or platforms, open structures outside of areas protected by handrails, ladders, buildup scaffolding or extendible platforms more than 20 feet above ground or elevated deck levels, ladders or scaffolding with overturning radii beyond the protection of deck level handrails, or cherry pickers shall wear safety belts.

- a. Close hydraulic hand valves on top of structural beam over wheel units one through eight.
- b. Retract jack screw on center of dolly.
- c. Retract actuator jacks on stage support A-frames to limit switch to clear engines.
- d. Lower transporter front dolly to extreme low position.
- e. Position dolly beneath the stage with the stage support A-frames (90M00335-1 and 90M00335-2) in line with stage fittings of station 115. Establish a center line fore and aft of the center longitudinal transporter beam. Attach plumb-bobs on the bottom center line of the stage at the top and bottom of thrust structure. Use these center lines as a guide to facilitate proper alignment.
- f. Raise the dolly until pins can be installed in stage support A-frames. Preload transporter front dolly to prevent pins from rotating. Insert pins into stage support A-frames and into the connecting linkage (90M01715). Use actuator jack to position stage support A-frames. (Attach one side at a time.)

- g. Attach and adjust the connecting linkage between stage support A-frame and S-IC stage station 248.000 attach fittings. The linkage should be adjusted so that the stage attach fittings are centered within the support structure slot.
- h. Rotate the jack screw on transporter front dolly to contact the stage and apply pressure.
- i. Attach forward lateral turnbuckle (90M00514) to the stage handling fitting at station 115 **Position I** per detail B.
- j. Open one-inch hand valves above each wheel unit slowly and in sequence 1-2, 3-4, 5-6, and 7-8.
- k. Lower stage weight onto transporter or raise transporter until stage weight is on transporter.
- l. Attach second turnbuckle to the stage per step "i".
- m. Tighten turnbuckles to 400 foot-pounds of torque.
- n. Apply 200 foot-pounds of torque to the jack screw. Assure that the stage longitudinal plane and transporter beams are parallel. If not, adjust connecting linkage and jack screw.
- o. Check clearance of stage support A-frames and stage support structure and adjust if required. The A-frames must not be touching the support structure.
- p. Verify that the fittings are centered $\pm 1/2$ inch within the front lateral beam of the transporter dolly. Adjust jack screw as required.
- q. Detach stage support A-frame actuators, jacks and brackets.
- r. Detach rotational brace from hoist per paragraph 4-4 in reverse order.
- s. Clear area of associated equipment.

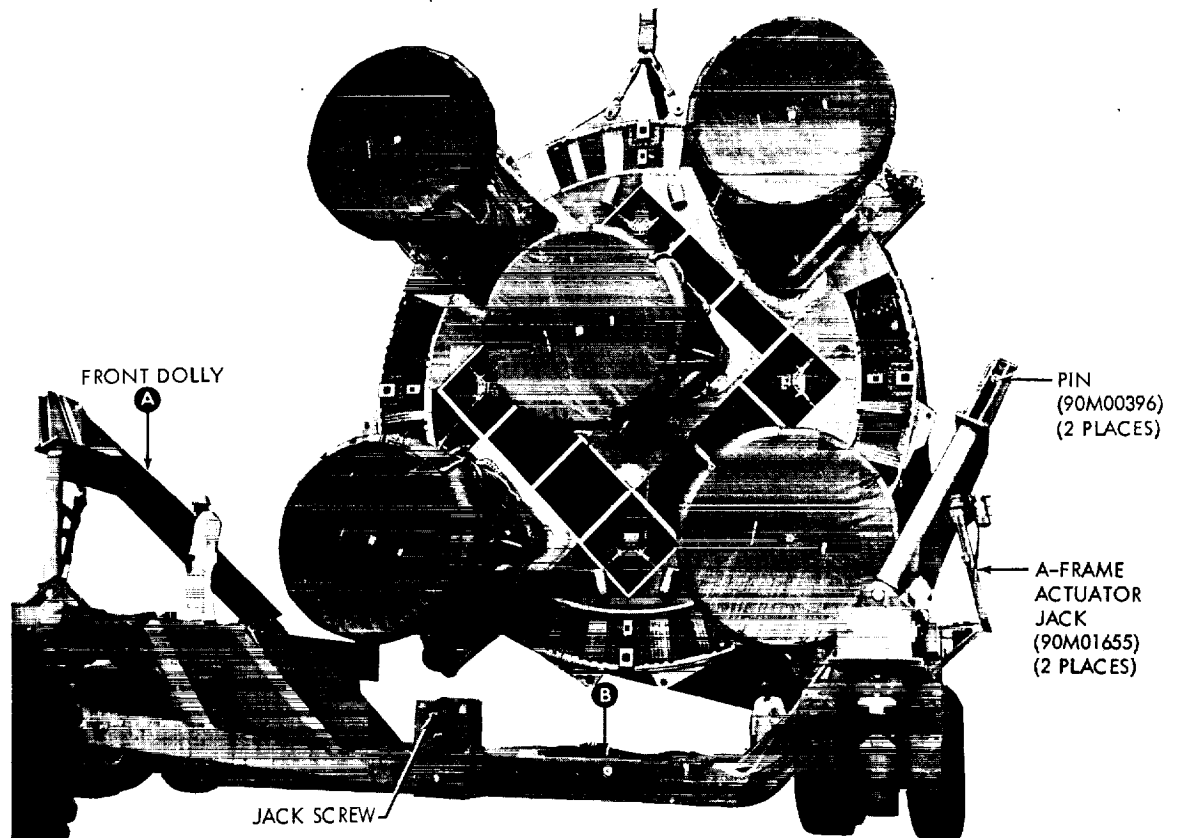
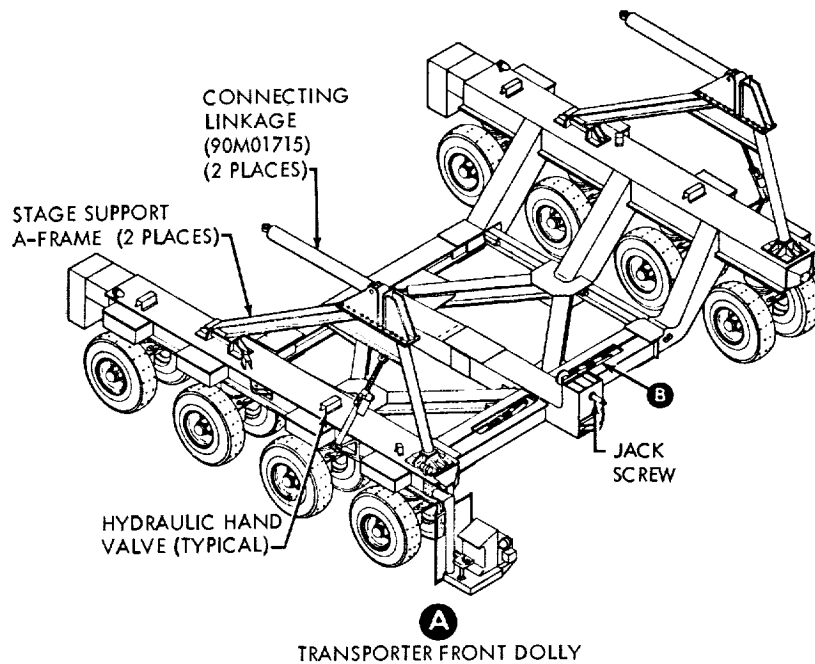
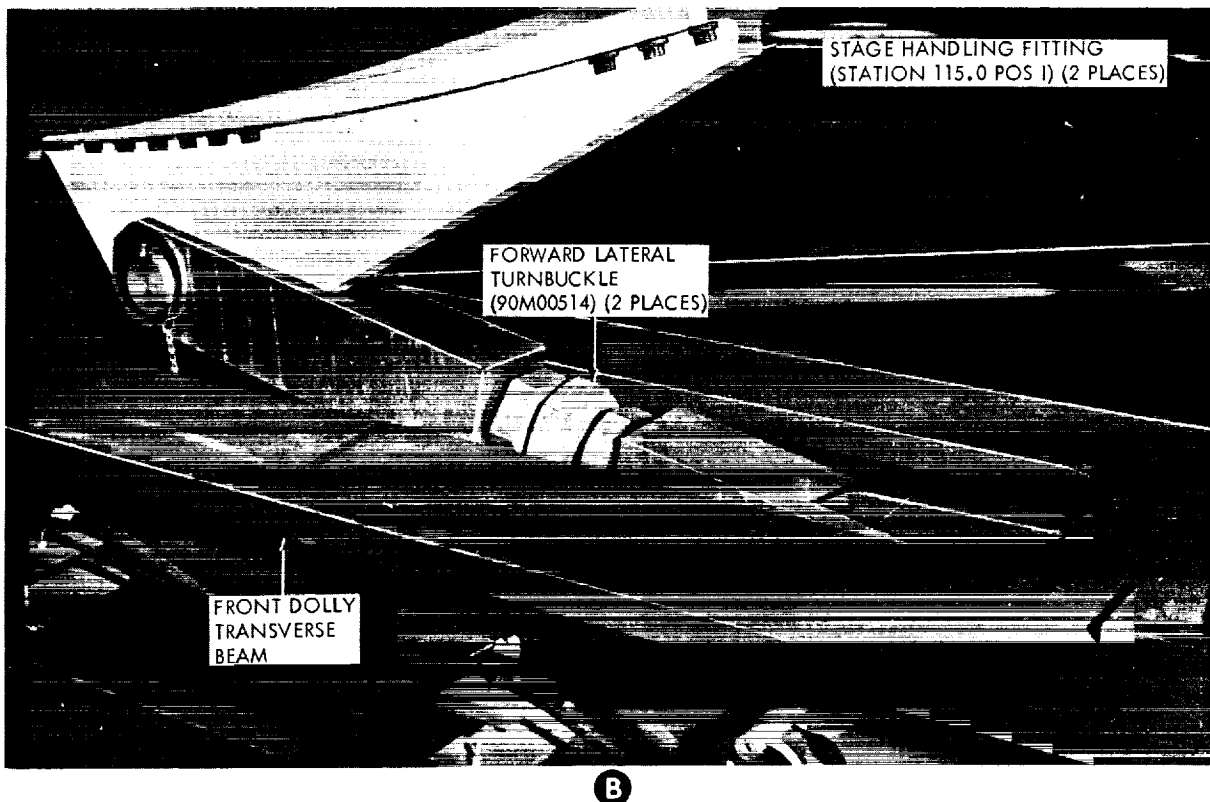


Figure 4-5. S-IC Transporter Loading - Front Dolly (Sheet 1 of 2)

t. Proceed with loading rear dolly per paragraph 4-7.



TRANSPORTER FRONT DOLLY



FORWARD LATERAL TURNBUCKLE ATTACHMENT

Figure 4-5. S-IC Transporter Loading - Front Dolly (Sheet 2 of 2)

4-7. S-IC TRANSPORTER LOADING (REAR DOLLY). Load the S-IC stage on the rear dolly of the transporter per figure 4-6 as follows:

WARNING

All personnel working on the S-IC stage or from suspended scaffolding or platforms, open structures outside of areas protected by handrails, ladders, buildup scaffolding or extendible platforms more than 20 feet above ground or elevated deck levels, ladders or scaffolding with overturning radii beyond the protection of deck level handrails, or cherry-pickers shall wear safety belts.

- a. Close the four hand hydraulic valves on top of the structural beam over wheel units nine through twelve.
- b. Remove "U" bolts and trunnion support caps from stage support A-frames.
- c. Position the transporter rear dolly beneath the stage with the trunnion support fittings (90M00410) in line with trunnions on the stage forward handling tool. Adjust trunnion support with A-frame actuator jacks as required.
- d. Raise dolly using hydraulic system to mate trunnions to trunnion supports.
- e. Install the trunnion support caps and "U" bolts.

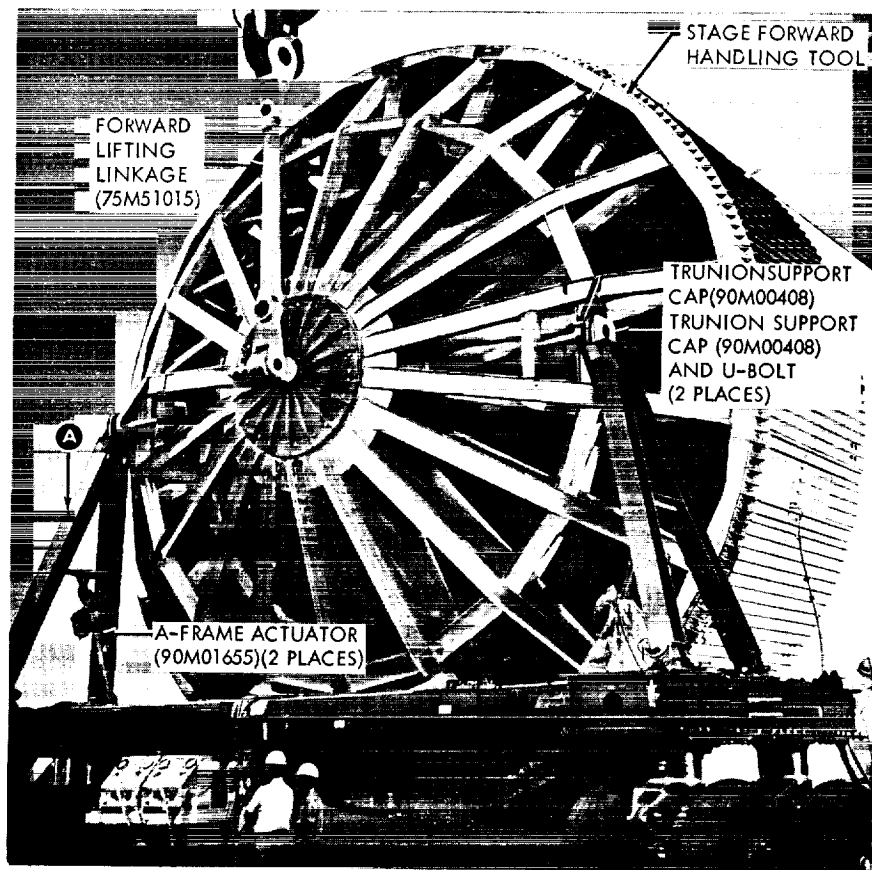
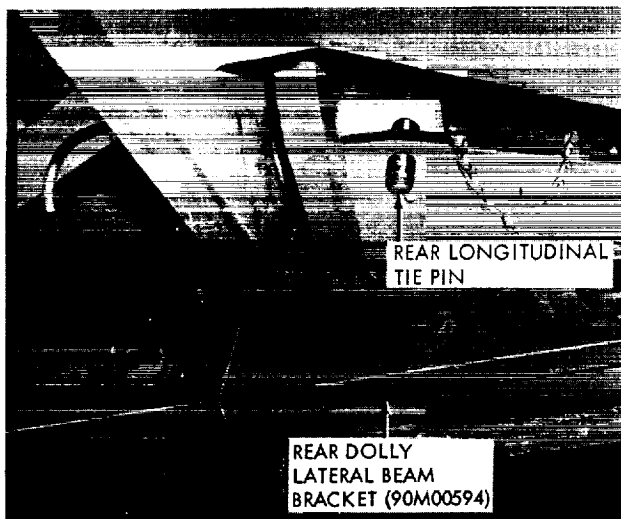
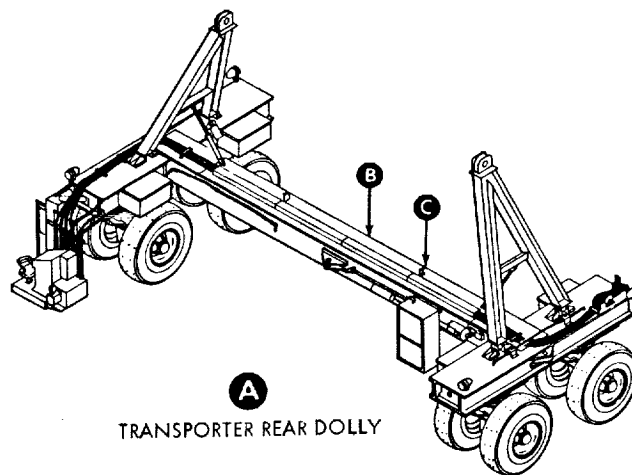
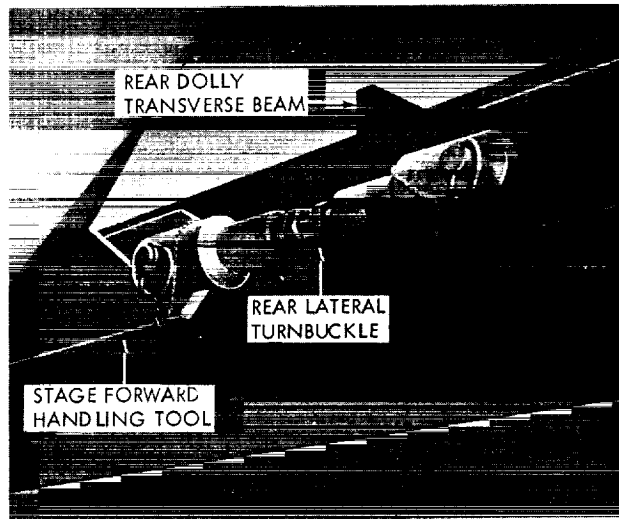


Figure 4-6. S-IC Transporter Loading - Rear Dolly (Sheet 1 of 2)

- f. Install longitudinal tie pin (90M00598) at station I to join rear dolly lateral beam and stage forward handling tool per detail B.
- g. Install one of the lateral turnbuckles (90M00427) between rear dolly and fitting on stage forward handling tool per detail C.
- h. Lower the S-IC stage to transfer weight from hoist to rear dolly.
- i. Attach second turnbuckle per step "g".
- j. Detach actuator jacks from A-frame.
- k. Open hydraulic valves.
- l. Apply 75-100 foot-pounds of torque to the turnbuckles.



B
LONGITUDINAL TIE PIN (90M00598)



C
LATERAL TURNBUCKLE (90M00427)

Figure 4-6. S-IC Transporter Loading - Rear Dolly (Sheet 2 of 2)

- m. Install messenger cable between front and rear dollies by reeling cable from winch assembly on rear dolly per figure 4-7 and connecting clevis on end of cable to dead end tongue on front dolly. Tighten messenger cable until it has approximately two feet of sag.
- n. Connect all electrical, air and communication lines at both ends between front and rear dollies and fasten to messenger wire per figure 4-8, detail C.

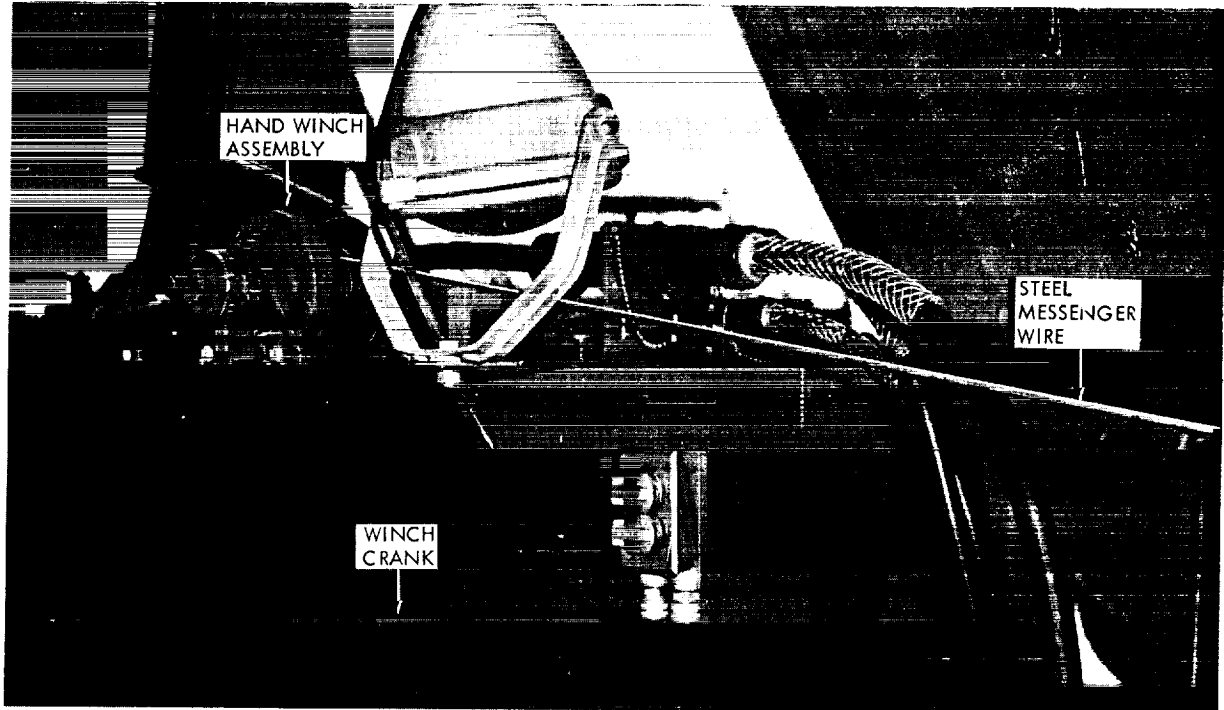


Figure 4-7. Transporter Rear Dolly Messenger Cable System

- o. Install tank pressurization and control system to rear dolly per paragraph 4-8.
- p. Detach hoist and forward lifting linkage from S-IC stage handling tool per paragraph 4-4 in reverse order.
- q. Raise or lower transporter until wheel unit struts are at their nominal position at 12 inches from fully retracted.
- r. Remove prime mover and tow bar from rear dolly. Stow associated gear.
- s. Verify stage attachment and attach prime mover per paragraph 3-11 for next operation.
- t. Move stage and transporter if necessary to remove aft rotational brace from the S-IC stage utilizing an overhead hoist.

WARNING

Personnel working on the S-IC stage will wear soft soled shoes and safety belts.

- u. Remove aft rotational brace (75M51009-6) from stage per paragraph 4-4 in reverse order and store in storage and handling fixture.

4-8. TANK PRESSURIZATION CONTROL AND MONITORING EQUIPMENT INSTALLATION. Install equipment per figure 4-8 as follows:

- a. Assure that equipment checkout has been performed per paragraph 3-13.

CAUTION

Verify that all hoses and fittings to be used with the LOX tank have been maintained LOX clean.

- b. Verify that all nitrogen tanks are fully charged to 1750 (\pm 100) psig with a gas meeting requirements of MSFC-SPEC-164.
- c. Raise dolly containing pressure control and monitoring system with forklift so fastening pins can be engaged to S-IC transporter rear dolly.
- d. Install pins, washers, and cotter pins per detail D.
- e. Spot clean surface of transporter dolly and pressure control and monitor unit with rotary stainless steel bonding brush or rotary abrasive disc. Apply brush intermittently, keeping cutting face parallel with surface. Inspect results after each application. Install bonding jumper (5) with maximum resistance 0.005 ohm.
- f. Attach facility gas per MSFC-SPEC-164 to "150 PSIG FACILITY SUPPLY" on the gas storage module.
- g. Plug power cable into 110 volt ac facility supply and activate modules.
- h. Attach pressure hoses to LOX and fuel tank pressure control modules per detail A.
- i. Attach sense lines to LOX and fuel tank pressure control modules.
- j. Extend hoses to respective LOX and fuel tank fittings. Position and temporarily fasten in place with finger tight fasteners and tape.
- k. Remove covers from sense lines and fasten to tanks per detail B.
- l. Remove covers from pressure lines.
- m. Start gas flow through pressure lines as purge.

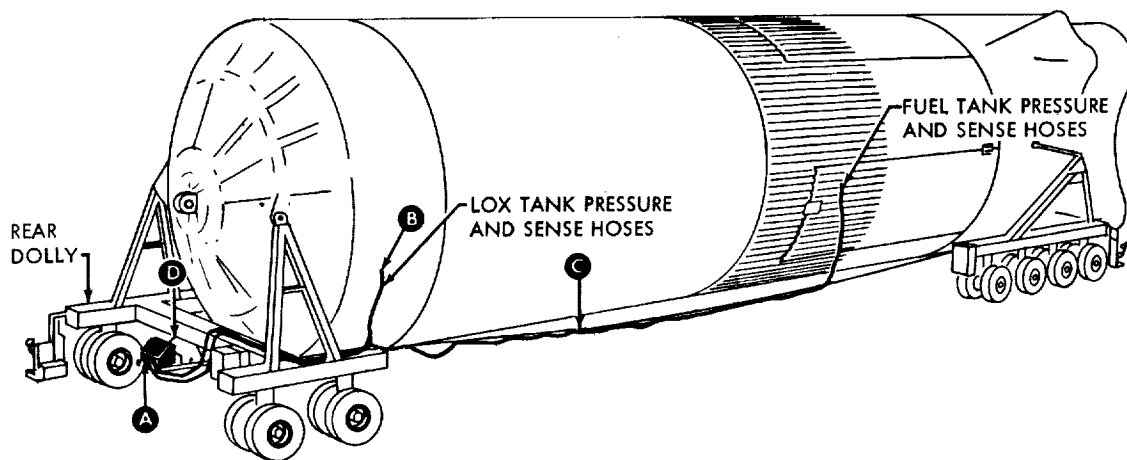


Figure 4-8. Tank Pressurization Control and Monitoring Equipment Installation (Sheet 1 of 2)

n. Attach lines to tanks without stopping gas flow per detail B.

o. Carefully position lines to installation configuration by fastening clamps and cable hangers per detail C.

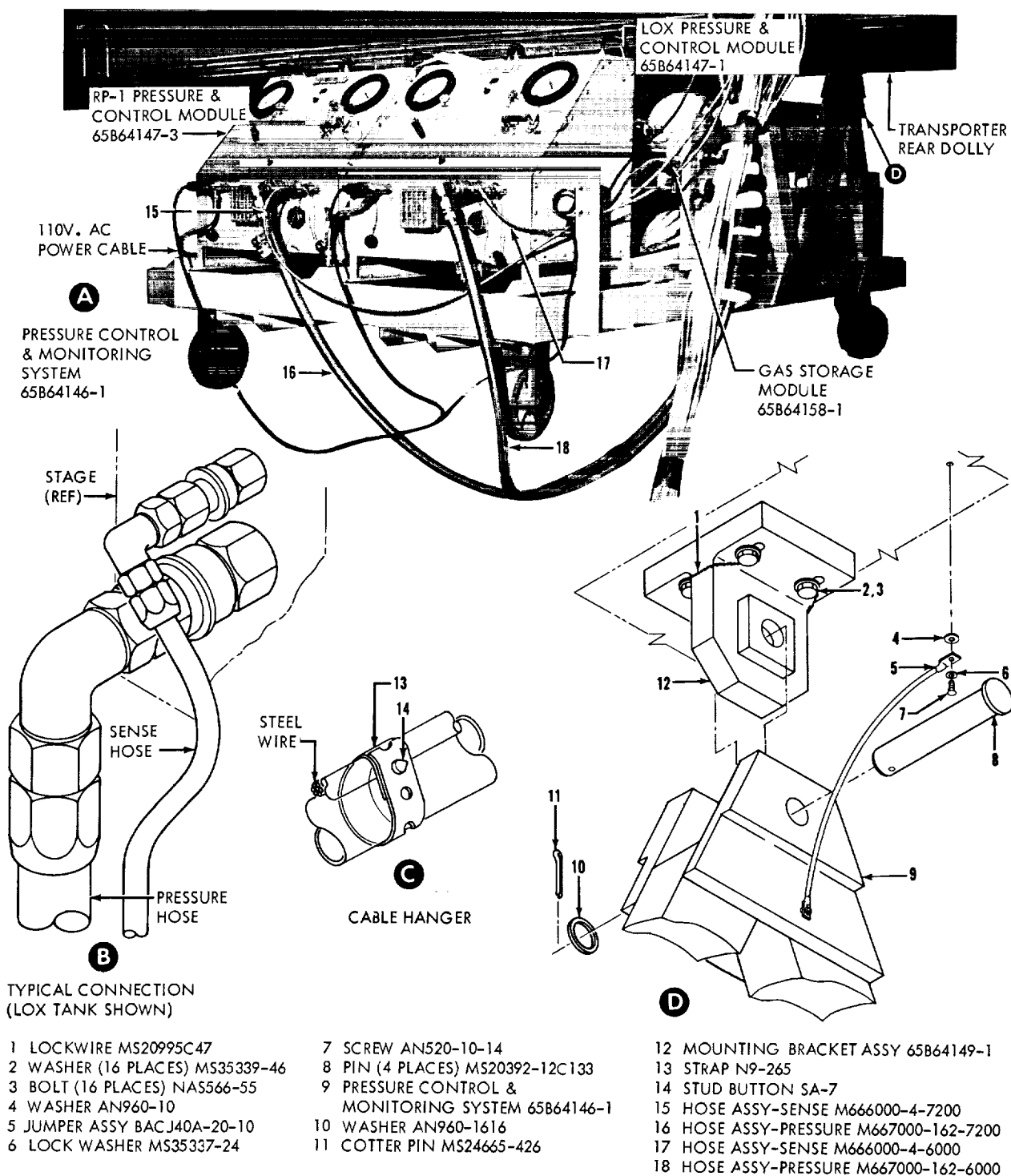


Figure 4-8. Tank Pressurization Control and Monitoring Equipment Installation (Sheet 2 of 2)

4-9. TRANSPORTATION DATA RECORDER INSTALLATION. Install recorder equipment LAS 170-NS per figure 4-9 as follows:

CAUTION

Do not try to operate recorder unless all sensors or termination modules are connected.

- a. Verify that equipment checkout was completed and calibrated per paragraph 3-14.
- b. Verify that a full roll of oscillograph paper was installed and that the impact chart paper roll is 1/4 full.
- c. Mount recorder on rear dolly per detail A.
- d. Layout and fasten cables with 2 inch or 3 inch Mystik tape (PPP-T-60 Type 1, Class 1) between recorder and sensor locations. Observe color codes on cable connectors.
- e. Mount sensors with 2 inch or 3 inch Mystik tape (PPP-T-60 Type 1, Class 1) as follows:
 - (1) Pitch/roll module 2 (LAS 4013376-3) mounted on S-IC transporter aft dolly. (To be repositioned later for KSC shipment per paragraph 6-7).
 - (2) Temperature/humidity module 3 (LAS 4013492-801) mounted on stage inside forward skirt area.
 - (3) Accelerometer module 4 (LAS 4013375-1) mounted on stage STA 1521, position I.
 - (4) Temperature/humidity module 5 (LAS 401392-805) mounted on stage approximately STA 702 position I.
 - (5) Accelerometer module 6 (LAS 4013375-5) mounted on stage STA 513, position I.
 - (6) Accelerometer module 7 (LAS 4013375-3) mounted on stage STA 116, position I.
 - (7) Temperature/humidity module 8 (LAS 403392-803) mounted on stage inside thrust structure area.

CAUTION

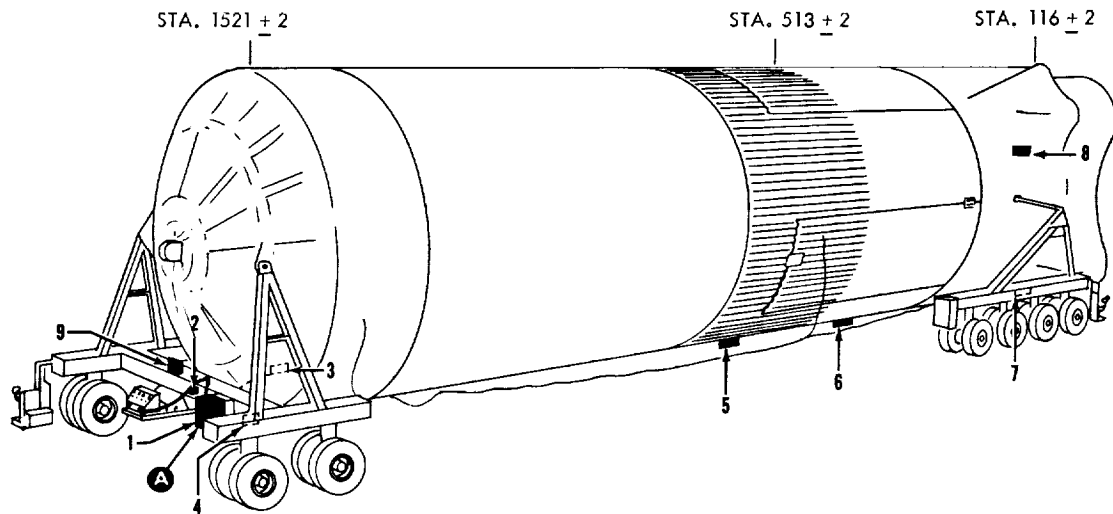
Do not try to operate recorder unless all sensors are connected.

- f. Connect cables between sensors and recorder. Observe color coding of cables.
- g. Connect power cable to transformer and transformer to 115 (\pm 5) volt ac source.

CAUTION

Do not operate recorder unless all sensors are connected.

- h. Set the AC power switch to ON and the CHARGE-STBY-OPERATE switch to OPERATE position and turn on the two switches on the recording oscillograph.
- i. Allow 10 minutes for components to stabilize and perform oscillograph verification per paragraph 4-10.
- j. Zero all counters.
- k. Mark chart paper lightly with pencil to establish a time reference.
- l. Carefully dress cable away from counter reset buttons and close recorder case.
- m. Close pressure equalizer valve on recorder case.



- | | | | |
|-------------------------|-----------------|-------------------------|-----------------|
| 1 RECORDER | 170-NS | 5 TEMP./HUMIDITY MODULE | LAS 4013492-805 |
| 2 PITCH & ROLL MODULE | LAS 4013376-3 | 6 ACCELEROMETER MODULE | LAS 4013375-5 |
| 3 TEMP./HUMIDITY MODULE | LAS 4013492-801 | 7 ACCELEROMETER MODULE | LAS 4013375-5 |
| 4 ACCELEROMETER MODULE | LAS 4013375-1 | 8 TEMP./HUMIDITY MODULE | LAS 4013492-803 |
| | | 9 TRANSFORMER | 23-22-125 |

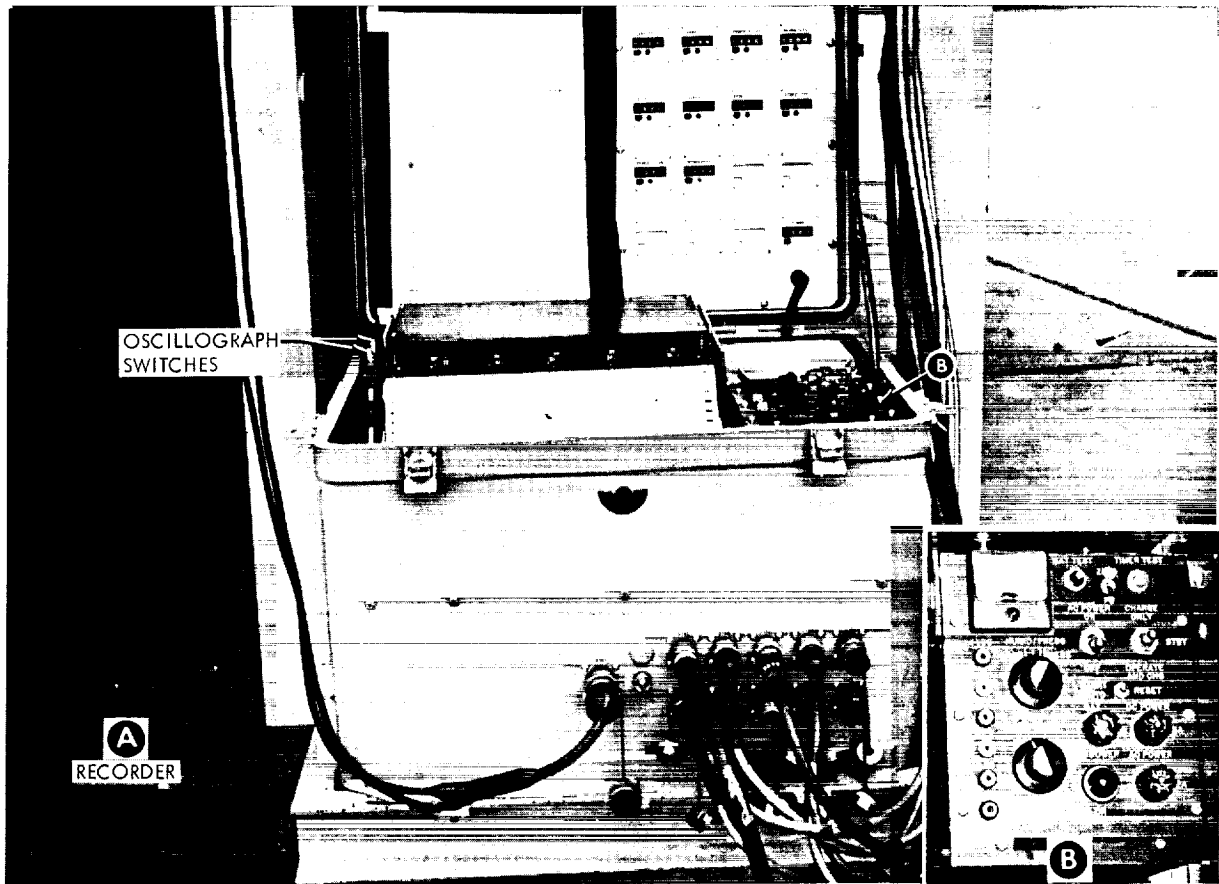


Figure 4-9. Transportation Data Recorder Installation

4-10. OSCILLOGRAPH OPERATION VERIFICATION. Perform the following per figure 3-9 to verify the controls and adjustments for proper operation of the oscillographic recorder.

- a. The chart drive is independently controlled by the CHART on-off switch on the upper left side of the oscillograph.



The POWER switch should be turned OFF except during actual recording or while making zero adjustments. Do not operate with RECORD switch ON while any of the transducers are disconnected as prolonged operation with the servos forcing the pens hard against the stops may result in damage.

- b. The pen amplifiers and chart drive are all energized by the POWER switch on the upper left side of the oscillograph.
- c. The ZERO, SPAN and GAIN screwdriver adjustments are accessible through holes in the top cover plate with the left-hand adjustments controlling the lower pen of each pair.

NOTE

The GAIN should be set just below the point of instability where pen jitters. Clockwise adjustment decreases servo gain.

- d. The amplifier output test points are accessible by raising the hinged pen deck. The output voltage should be approximately +6 v with the pen at rest and from 2 to 10 volts when the pen is slewing. The pen deck is hinged at the rear and can be swung upward through 90 degrees after loosening the two hold-down screws.
- e. Assure that chart paper is feeding smoothly at 1 (\pm .005) inches per minute.
- f. Assure pens are positioned properly per paragraph 3-14.
- g. Verify that recording pen pressure is not too light to give skipping traces or too heavy so pen tilts away from vertical when pen is slewing and while chart is in motion.

4-11. S-IC STAGE FORWARD COVER - INSTALLATION. Install forward cover (90M01723-1) per figure 4-10 as follows:

- a. Carefully spread out the three sections of the cover exterior side up on a clean floor adjacent to the S-IC stage.
- b. Roll top section starting at edge A to seam B which will rest on edge of the stage forward skirt.
- c. Roll top section from sides C and D.
- d. Roll top section back side E toward previous rolls.



All personnel working from suspended scaffolding or platforms, open structures outside of areas protected by handrails, ladders, buildup scaffolding or extendible platforms more than 20 feet above ground or elevated deck levels, ladders, or scaffolding with overturning radii beyond the protection of deck level handrails, or cherry-pickers shall wear safety belts.

- e. Lift onto S-IC stage and position.
- f. Unroll section in reverse order of rolling starting toward side E.

- g. Roll section covering stage between positions I and II starting from edge with opening for transporter at position I.
- h. Lift onto S-IC stage and zipper top section at position II.
- i. Roll remaining section for positions I to IV per step "g" and mate with tip section at position IV.

CAUTION

Do not attempt to zipper bottom seam at stage position I until cover has hung, stretched and shaped for minimum of 12 hours. The bottom seams and zippers could be damaged.

- j. Zipper up bottom seam at position I after waiting for covers to stretch and shape and adjust the straps for best fit.

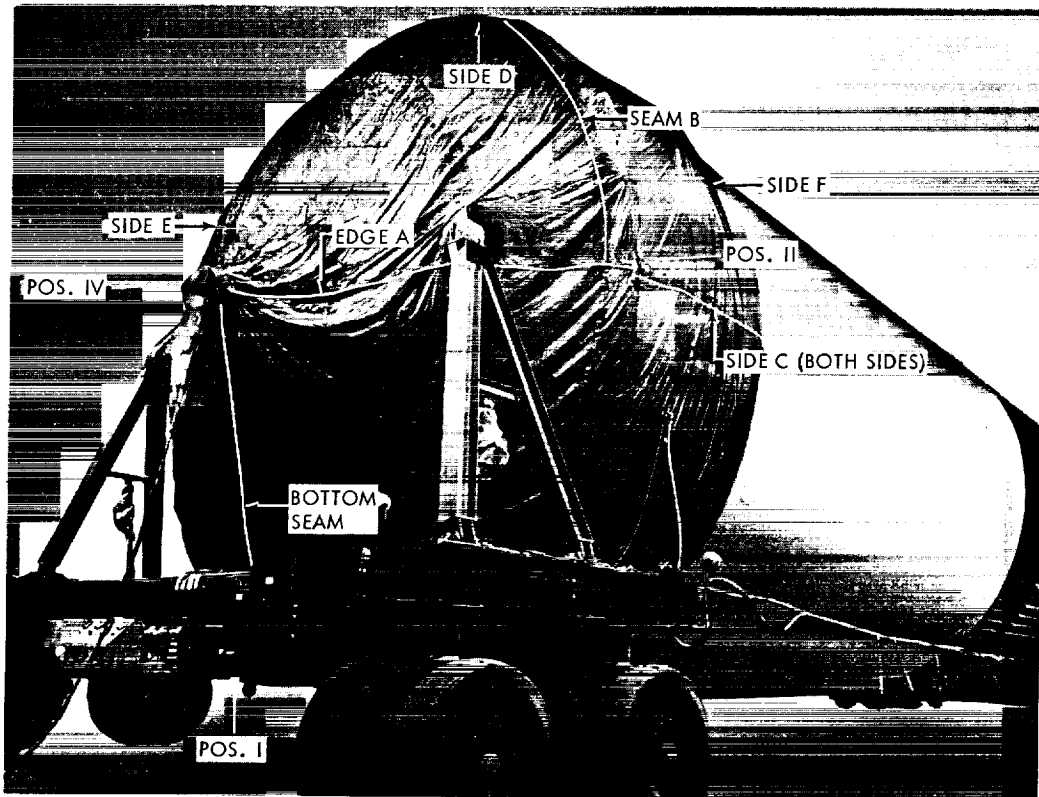


Figure 4-10. S-IC Stage Forward Cover - Installation

4-12. S-IC STAGE AFT COVER - INSTALLATION. Install aft cover (90M01781-1) per figure 4-11 as follows:

- a. Carefully spread out the four sections of the cover exterior side up on a clean floor adjacent to the S-IC stage.
- b. Zipper together the top left side with the top right side to the point corresponding with the end of the stage thrust structure.
- c. Roll portions of covers that would cover engines toward aft end of thrust structure.
- d. Roll portions of covers that would cover thrust structure toward the aft end of thrust structure.

WARNING

All personnel working from suspended scaffolding or platforms, open structures outside of areas protected by handrails, ladders, buildup scaffolding or extendible platforms more than 20 feet above ground or elevated deck levels, ladders or scaffolding with overturning radii beyond the protection of deck level handrails, or cherry-pickers shall wear safety belts.

- e. Lift top left side and top right side rolled panels in place over handling fittings at stage Position III with crane and nylon straps. Spreader bar assembly MMB43246 may be utilized.
- f. Unroll panels over thrust structure.
- g. Unroll panels over engines.
- h. Complete zippering of top left side and top right side panels and fasten straps.
- i. Mate and zipper bottom right side panel to top right side panel and fasten straps at stage Position IV.
- j. Mate and zipper bottom left side panel to top left side panel and fasten straps at stage Position II.

CAUTION

Do not attempt to zipper bottom seam at stage Position I until cover panels have hung, stretched and shaped for a minimum of 12 hours. The bottom seams and zippers could be damaged.

- k. Zipper up the bottom seam and fasten straps at stage Position I after waiting for covers to stretch and shape.
- l. For trips from Michoud to MTF and return individual engine covers MMB43247-1, MMB43247-3 and MMB43247-5 may be substituted for 90M01781-1 cover and installed per MMB43249-1 and MMB43249-3.

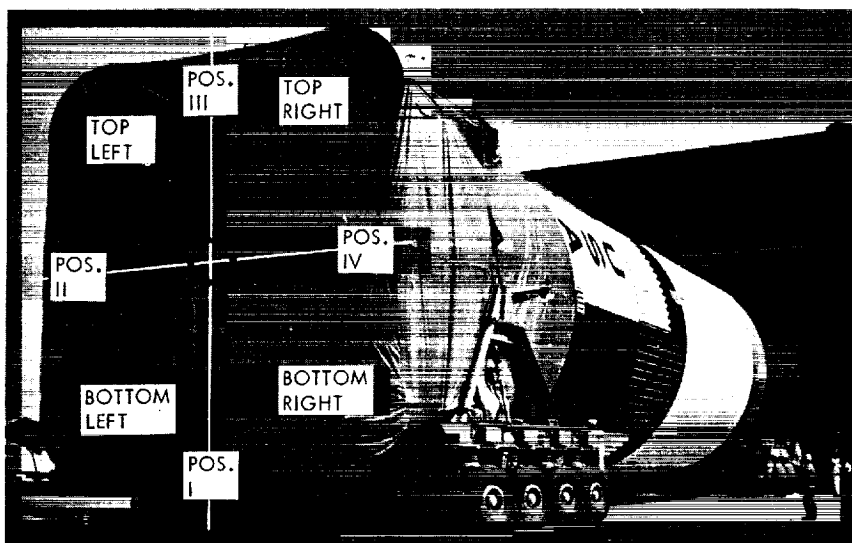


Figure 4-11. S-IC Stage Aft Cover - Installation

SECTION V
S-IC STAGE TOWING5-1. INTRODUCTION.

5-2. This section provides procedures for activating prime mover and transporter, attaching tow bar, activation of tank pressure control and monitor unit, instrumentation recording and towing.

5-3. PRIME MOVER AND TRANSPORTER ACTIVATION. Perform the following prior to tow bar hookup:

- a. Perform prime mover checkout per paragraph 3-8.
- b. Perform auxiliary power unit checkout per paragraph 3-9.
- c. Perform transporter checkout per paragraph 3-10.

5-4. PRIME MOVER/S-IC STAGE TRANSPORTER TOW BAR INSTALLATION. Install tow bar per paragraph 3-11.

5-5. PRIME MOVER AND TRANSPORTER CHECKOUT WITH S-IC STAGE ATTACHED. Proceed with checkout per paragraph 3-5 as follows:

- a. Perform pre-start checkout and start operation of Onan generator per paragraph 3-9.
- b. After warm-up, perform the following adjustments:
 - (1) VOLTMETER-AMMETER SELECTOR SWITCH to position No. 1.
 - (2) Energize FIELD CIRCUIT BREAKER.
 - (3) VOLTMETER should read 470 (± 10) vac.
 - (4) Adjust VOLTAGE REGULATOR for 465 (± 5) vac on voltmeter.
 - (5) Rotate VOLTMETER-AMMETER SELECTOR SWITCH to positions No. 2 and No. 3 and observe voltages. They should be the same as position No. 1. Return to position No. 1 for operation.

CAUTION

If during operation, the low oil pressure, high water temperature or overspeed mechanism should stop the unit, investigate the cause and correct. Repeat starting procedure.

- c. Onan generator unit is now ready for operation.
- d. Checkout S-IC transporter steering, hydraulic and braking system as follows:

CAUTION

Do not apply transporter brakes by both console operators at one time either in motion or parked. Undue stress may be produced in the S-IC stage.

- (1) Thoroughly check hydraulic system for leaks and open valves.
- (2) Inspect all electrical cables visually for damage and tight electrical connections. Verify messenger cable and hangers for proper installation.

- (3) Check wheels for turning clearance. Remove all loose items from transporter and stage.
- (4) Turn MAIN CIRCUIT BREAKERS to OFF on both consoles. Turn right and left BEAM SWITCHES to OFF on both consoles.
- (5) Verify output voltage and frequency of Onan generator unit. Voltage should be 470 (± 10) volts and frequency 60 (± 2) cycles.
- (6) Test intercommunication system.
- (7) Actuate MAIN LOAD CIRCUIT BREAKER on the left side of the Onan generator to ON position.

NOTE

Steps(8) and (9) are applicable to the forward towed dolly only.

- (8) Verify PHASE ROTATION LIGHT on main breaker of forward towed dolly console is ON.

WARNING

Always maintain MAIN CIRCUIT BREAKER at OFF position at the console of transporter unit not directly connected by tow bar to the prime mover. Install a protective cap on the male electrical plug of unused power cable, to eliminate any possibility of personnel injury.

- (9) Actuate MAIN CIRCUIT BREAKER at rear of console of transporter unit connected to M26-A1 prime mover to ON.
- (10) Actuate KEY SWITCHES on both consoles to ON to apply power to control system.

NOTE

Some of the RED ERROR LIGHTS on annunciator may come ON and the HORN will SOUND when power is first applied. Press ACKNOWLEDGE button to squelch horn. Press RESET button when wheels stop steering action. All error lights should go out. If lights do not go off, turn KEY SWITCH to OFF and determine cause of malfunction.

- (11) Verify voltage on front or rear dolly voltmeter at 470 (± 10) volts.

NOTE

Meter on rear dolly will not operate when supplied power from front dolly and vice-versa.

- (12) Permit system to warm up approximately fifteen minutes.
- (13) Actuate right and left BEAM SWITCHES to ON at both consoles.
- (14) Set MODE SWITCH on both console panels to ACKERMANN.
- (15) Set STEERING INPUT switches to IND operator control on both consoles.
- (16) Set both STEERING RATE switches for rate 1 on units serial numbers 101, 102 and 103.
- (17) Press TEST switch on front console. ALL LIGHTS on the annunciator should come ON and the HORN should SOUND on both consoles. If not, determine cause of malfunction and correct.
- (18) Press RESET switch on front console. LIGHTS should go off. Press ACKNOWLEDGE switch and horn should go off.
- (19) Press TEST switch on rear console. ALL LIGHTS on the annunciator should come ON and the HORN should SOUND on both consoles. If not, determine cause of malfunction and correct.

- (20) Press RESET switch on rear console. LIGHTS should go OFF. Press ACKNOWLEDGE switch and HORN should go OFF.
- (21) Observe Ackermann (A) - Parallel (P) lights on annunciator. If Ackermann light is not on, the Parallel light will be. This indicates that the steering system is "NOT ZERO" and Ackermann to Parallel switching cannot occur. Move steering lever in proper direction until steering angle reads zero. At this time, the Parallel light should go out and the Ackermann light should come on.
- (22) Displace front dolly steering lever in either direction and observe wheel units for proper operation.
- (23) Transfer operation to rear control. Displace rear dolly steering lever in either direction and observe wheel units for proper operation. Return to zero degrees.
- (24) Set MODE switch to PARALLEL.
- (25) Displace rear dolly steering lever in either direction and observe wheel units for proper operation. Return to zero degrees.
- (26) Transfer operation to front control. Displace front dolly steering lever in either direction and observe wheel units for proper operation. Return to zero degrees.
- (27) The steering system is now ready for normal operations.

5-6. TANK PRESSURE CONTROL AND MONITOR UNIT FINAL VERIFICATION. Final verification of tank pressure control and monitor unit in self-sustained mode prior to movement of S-IC stage is per figure 3-7 as follows:

WARNING

Comply with all safety precautions. Do not operate with panels removed. Verify that pressure connections are secure before pressure is applied. Do not vent without warning nearby personnel.

CAUTION

Do not leave unit unattended while 4-way valve is in the "20 PSIG FILL" position.

- a. Visually inspect the unit for damages.
- b. Verify the tank pressure indicator gage (12) is correct by comparing it with a calibrated tank pressure gage.
- c. Verify LOX tank pressure supply system high pressure relief valve as follows:
 - (1) Connect a variable 0 to 250 psig LOX clean gas supply to the "150 PSIG MAXIMUM GAS SUPPLY" (19) port.
 - (2) Place the 2-WAY VALVE (1) in the "AUXILIARY" position.
 - (3) Place the 4-WAY VALVE (13) in the "AUTOMATIC REGULATOR" position.
 - (4) Connect the portable pneumatic calibration unit (PPCU) (figure 2-1) with a 30 psig master gage and a shut off valve to the "TANK PRESSURE SUPPLY" fitting (15). Close the shut off valve.
 - (5) Slowly increase the supply pressure and verify that the high pressure relief valve opens at 200 (± 10) psig.
 - (6) Reduce the supply pressure and verify that the high pressure relief valve closed at 170 psig minimum.
- d. Verify LOX tank pressure supply system 20 psig regulator as follows:
 - (1) Reduce the supply pressure to 150 psig by venting through the tank supply shut off valve attached to the PPCU. Maintain 150 psig supply pressure.
 - (2) Open the metering valve on PPCU to tank supply pressure.

- (3) Place the 4-WAY VALVE (13) in the "20 PSIG FILL" position.
 - (4) Verify the 20 psig regulator will regulate tank supply pressure 20 (± 2) psig by slowly closing the metering valve opened in step (2).
- e. Verify LOX tank pressure supply system 3 psig regulator as follows:
- (1) Place the 4-WAY VALVE (13) in the "AUTOMATIC REGULATOR" position.
 - (2) Install a 0 to 10 psi gage and shutoff valve at the tank supply port (15) in place of the 30 psi gage. Do not connect the 0 to 10 psi LOX supply to the tank supply port until step "f".
 - (3) Verify the 3 psig regulator will regulate tank supply pressure to 3 (± 0.75) psig by cracking the PPCU pressure shutoff valve.
- f. Verify LOX tank pressure supply system 5 psig relief valve as follows:
- (1) Connect a variable 0 to 10 psi LOX clean gas supply to shutoff valve installed in step e.
 - (2) Slowly increase the tank supply pressure and verify that the 5 psig relief valve opens at 5 (± 0.25) psig.



Do not increase the pressure to more than 7 psig.

- g. Verify LOX tank pressure supply system negative relief valve as follows:
- (1) Remove the protective cap from the NEGATIVE RELIEF VALVE (16). Apply pressure to the TANK SUPPLY fitting (15) to seat the NEGATIVE RELIEF VALVE. Do not exceed 7 psig. After the valve seats, maintain 2 psig on the TANK SUPPLY fitting.
 - (2) Install a 0 to 5 psig pressure gage and adapter fitting to NEGATIVE RELIEF valve (16).
 - (3) Apply 3 (± 0.5) psig to the TANK SUPPLY fitting (15).
 - (4) Reduce the pressure to the TANK SUPPLY fitting (15) slowly and verify that the NEGATIVE RELIEF VALVE (16) opening at 0.1 (± 0.03) psid by the pressure rise on the 0 to 5 psig gage.
 - (5) Slowly increase pressure at the TANK SUPPLY fitting (15) and verify that the NEGATIVE RELIEF VALVE (16) closes at 0.5 psid maximum pressure.
 - (6) Reduce the system pressure to atmospheric.
 - (7) Disconnect the PPCU equipment from the TANK SUPPLY fitting (15) and the NEGATIVE RELIEF VALVE (16). Replace the NEGATIVE RELIEF VALVE protective cover.
- h. Verify pressure sensing system as follows:
- (1) Connect a 0 to 5 psig gage, a metering valve, a bleed valve and a 0 to 10 psig LOX clean gas supply to the TANK SENSING fitting (14).
 - (2) Connect 115 VAC power to the 115 VAC power input receptacle (20).
 - (3) Turn the 150 psi gas supply OFF but do not disconnect.
 - (4) Place the 2-WAY VALVE (1) in the FACILITY position.
 - (5) Place the 4-WAY VALVE (13) in the MANUAL RELIEF position and verify that the SUPPLY PRESSURE drops to zero.
 - (6) Turn the POWER SWITCH to ON and verify the following:
 - (a) WARNING horn (18) sounds intermittently. Horn may be silenced by the "HORN SILENCE" switch (17).
 - (b) WARNING light (8) FLASHES intermittently.

- (c) POWER ON light (4) is ILLUMINATED.
 - (d) TANK PRESSURE BELOW NORMAL light (5) is ILLUMINATED.
 - (e) AUXILIARY GAS IS BEING USED light (7) is ILLUMINATED.
 - (7) Slowly increase the pressure on the sensing line and verify the following:
 - (a) WARNING light (8) and AUXILIARY GAS IS BEING USED light (7) both are OFF at 1.0 psig maximum.
 - (b) TANK PRESSURE BELOW NORMAL light (5) is OFF at 2.0 psig maximum.
 - (c) WARNING light (8) and HORN (18) both are ON again at 5.0 psig maximum.
 - i. Turn on the 150 psig gas supply. The SUPPLY PRESSURE gage (2) remains at ZERO verifying that the solenoid valve controlling flow to regulators is closed.
 - (1) Position the 4-WAY VALVE (13) to the AUTOMATIC REGULATE position.
 - (2) Slowly decrease the sensing line pressure and verify the following:
 - (a) WARNING light (8) is OUT at 4.4 psig minimum.
 - (b) TANK PRESSURE BELOW NORMAL light (5) is ON at 1.4 (± 0.1) psig.
 - (c) WARNING light (8) and HORN (18) and AUXILIARY GAS IS BEING USED light (7) are ON at 0.6 psig (± 0.1).
 - (d) SUPPLY PRESSURE gage (2) shows increased pressure at 0.6 psig minimum thus indicating the solenoid valve opened.
 - j. Reduce all pressures to zero, disconnect all equipment and reinstall all protective covers.
 - k. Repeat steps "c" through "h" for fuel tank module.
- 5-7. TANK PRESSURE CONTROL AND MONITOR UNIT ACTIVATION. Activate the tank monitor and control to self-sustained mode per figure 3-7 as follows:
- a. Remove electrical supply from facility source.



Assure that transporter electrical polarity is correct as indicated by light on main circuit breakers on forward towed dolly consoles.

- b. Plug electrical supply plug into transporter outlet for 115 VAC.
- c. Disconnect facility gas line from 150 PSIG FACILITY SUPPLY fitting (25) and cap.
- d. Place 2-WAY CONTROL VALVE (1) in the AUXILIARY GAS SUPPLY POSITION.
- e. Assure that all manual valves except the cylinder fill (28) and manual relief (21) on the gas storage module are open.
- f. Set tank pressure to compensate for temperature differences anticipated during towing per calculations in 66B10952.



Do not tow S-IC stage out of any building or barge until requirements of 66B10952 are satisfied.

5-8. TRANSPORTATION DATA RECORDER ACTIVATION. Activate equipment per figure 3-8 as follows:

- a. Verify that checkout has been accomplished per paragraph 3-14.
- b. Verify that impact chart transport has sufficient chart paper used at the rate of approximately one foot per day for the intended move.
- c. Verify that oscillograph recorder has fresh roll of paper.
- d. Plug lead from isolation transformer into 110 VAC outlet on S-IC transporter.
- e. Turn unit ON and allow to warm up for 30 minutes.
- f. Loosen the screws and remove the upper base plate from the data and recorder case, and place it on a suitable support outside the unit.
- g. Set the CHARGE-STBY-OPERATE switch to OPERATE.
- h. Hold the ZERO/F.S. switch in the ZERO position to energize the zero calibrate circuits.
- i. Turn on the oscillograph switches at the top left side of the oscillograph.



The oscillograph pens may not move into alignment with the calibrated lines on the chart paper. Do not attempt to manually position the pens at any time.

- j. Measure the ZERO calibrate voltage at the input test point for channel 1 of the oscillograph. If necessary, adjust the channel 1 zero adjust potentiometer to obtain 0.000 volts.
- k. Repeat the ZERO calibrate voltage measurement for oscillograph channels 2, 3, and 4.
- l. Verify that the oscillograph pens write on the chart zero lines for all channels. If not, adjust the pen ZERO potentiometers to align the pen traces with the zero lines.
- m. Hold the ZERO/F.S. switch in the full scale F.S. position to energize the full-scale calibrate circuits.
- n. Measure the FULL-SCALE calibrate voltage at the input test point for channel 1 of the oscillograph. If necessary, adjust the channel 1 F.S. Adjust potentiometer to obtain 1.000 volts.
- o. Repeat the FULL-SCALE calibrate voltage measurement for oscillograph channels 2, 3, and 4.
- p. Verify that the oscillograph pens write on the chart full-scale lines for all channels. If not, adjust the pen SPAN potentiometers to align the pen traces with the full-scale lines.
- q. Set the HUMID/PRESS switch to HUMID.
- r. Adjust the humidity channels to full scale, using the pen SPAN adjustments on the oscillograph.
- s. Set the HUMID/PRESS switch to PRESS.
- t. Measure the voltage at the INPUT TEST POINT for channels 5 and 6 on the oscillograph. If necessary, adjust potentiometers R2 and R4 to obtain 1.000 volt inputs, which should align the pen traces with the chart full-scale lines.
- u. Measure the voltage at the INPUT TEST POINT for channels 9 and 10. If necessary, adjust R6 and R8, respectively, to obtain 1.000 volts input. Adjust the pen SPAN potentiometers for channels 9 and 10 to align the pen traces with the chart full-scale lines.
- v. Adjust each channel GAIN potentiometer counterclockwise until the pen becomes active, then slowly clockwise to reduce the activity. Slight activity is desirable and produces maximum accuracy.

- w. Zero all the counters in the recorder case cover by depressing the reset button just below each counter dial.

NOTE

The time counter and chart transport may advance one position if the timer is at the 15-minute timing interval when power is applied to the recorder circuits. If this occurs, the affected counters should be reset and a notation made on the chart.

- x. Reset the counters.
- y. Switch power to transporter 110 VAC outlet when transporter power is available.
- 5-9. TOWING S-IC STAGE - GENERAL. Perform towing per figure 5-1 as follows:
- Assure that all items in paragraphs 5-3 through 5-8 have been accomplished.
 - A Security escort and fire fighting equipment is provided any time the S-IC stage enters a roadway.
 - Towing speed will not exceed five miles per hour.
 - Extreme caution must be observed when maneuvering in excess of a 20° turn. Monitor wheel loading constantly.
 - Do not exceed 6% grade or slope at any time.
 - Operators must remain at the controls of the transporter at all times from prime mover and auxiliary power activation, during movement of the stage, parking and until prime mover and auxiliary are deactivated.
 - All steering is to be done by one operator except in extreme cases.
 - The towing operation will stop until correction has been made if an error light appears on annunciator panel during S-IC movement.

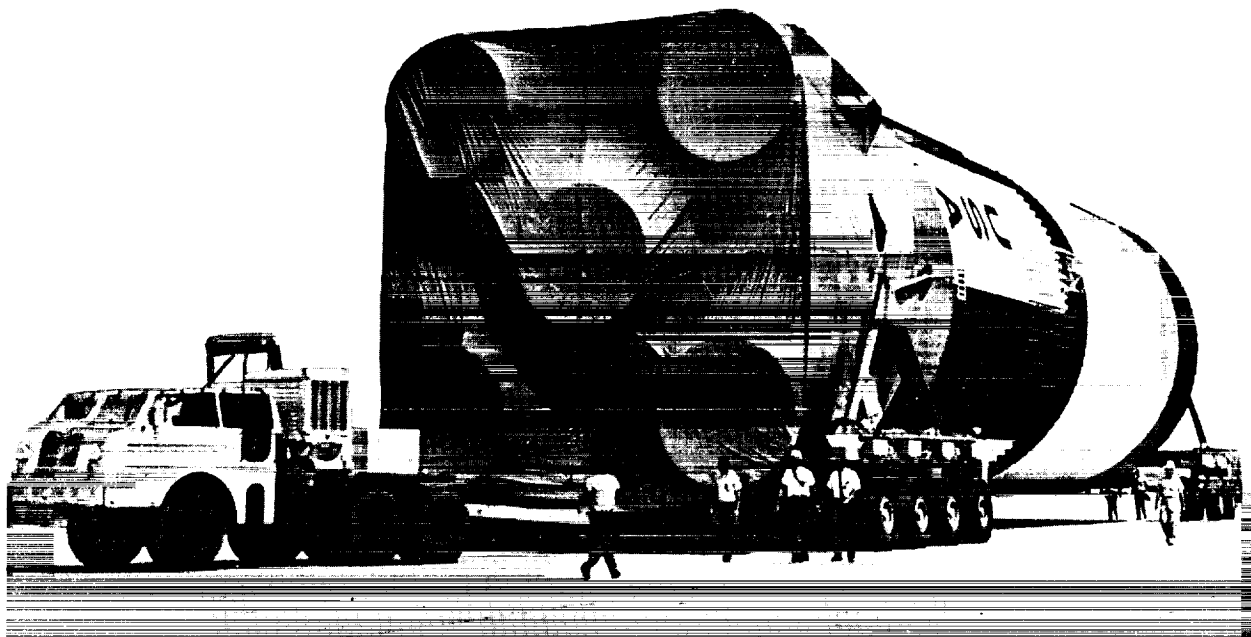


Figure 5-1. Towing S-IC Stage - General

- i. Transporter brakes will not be applied during movement by the front and rear console operator at the same time. Brakes will be applied while in motion only by prime mover operator or one console operator.



Do not apply transporter brakes by both console operators at one time either in motion or parked. Undue stress may be produced in the S-IC stage.

- j. Apply front and rear brakes individually when stage is in parking position.
- k. Transporter wheels will be chocked if stage is parked for any reason.
- l. If at any time control operators leave their stations, after parking, power must be removed at auxiliary power main load circuit breaker.

SECTION VI
BARGE OPERATIONS6-1. INTRODUCTION

6-2. This section provides procedures for barge preparation and checkout, loading, tie down, environment equipment connection, enroute tank pressure control and data monitoring and unloading. Ocean-going barges Poseidon, Point Barrow and Orion are used to transport the S-IC stage from Michoud to the Kennedy Space Center. River barges Little Lake and Pearl River transport to and from the Mississippi Test Facility.

6-3. BARGE PREPARATION AND CHECKOUT.- POSEIDON, POINT BARROW OR ORION. Prepare and checkout barges per figure 6-1 as follows:

- a. Verify that electrical power and nitrogen gas systems (Detail B) are operating properly and the gas storage bottles are filled.
- b. Checkout humidity control equipment (Detail A) and assure that sufficient dry desiccant is available.
- c. Checkout barge A-frame assembly (90M01477) to assure proper operation.
- d. Checkout operation of longitudinal tie down assembly (Detail C).
- e. Checkout operation of lateral tie down turnbuckle assemblies (90M01729-1) (Detail D).
- f. Pre-position longitudinal tie down assembly.
- g. Pre-position lateral tie down turnbuckle assemblies.

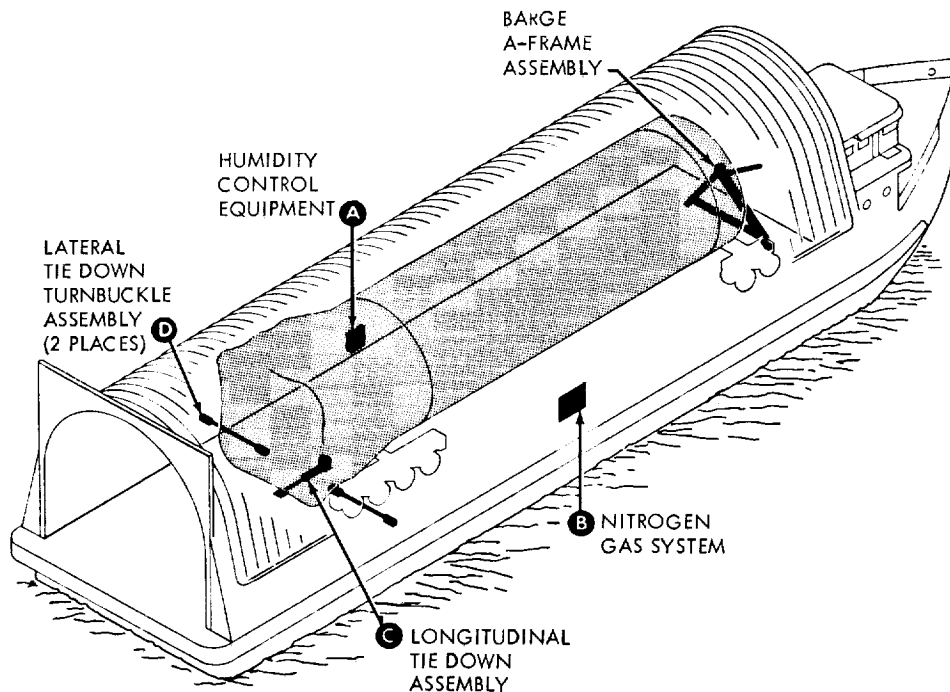
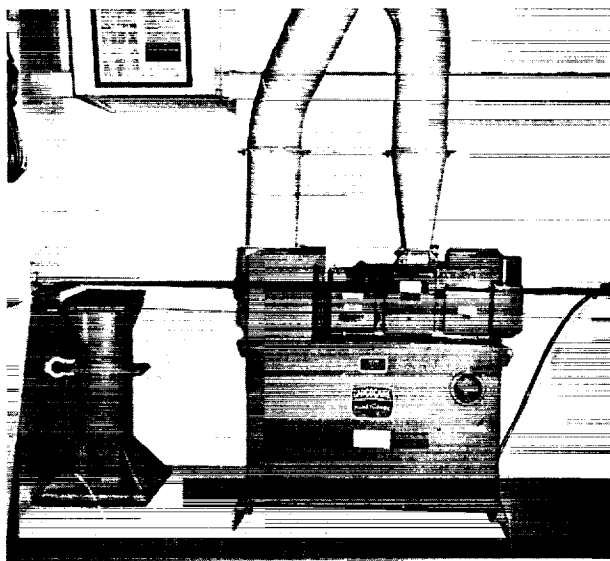
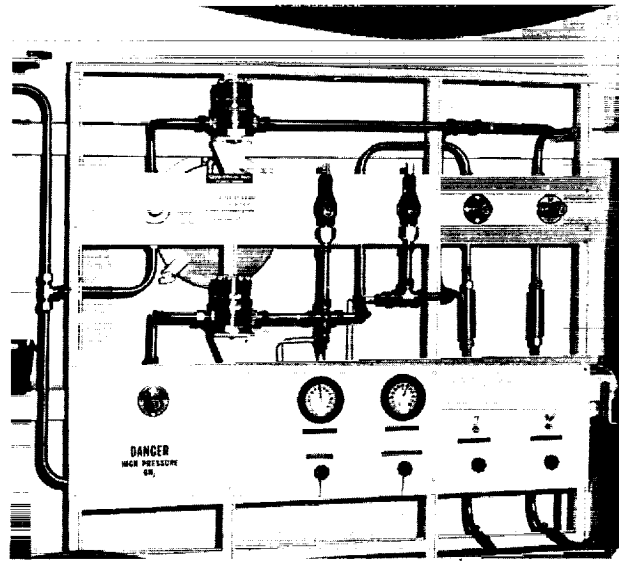


Figure 6-1. Barge Preparation and Checkout - Poseidon, Point Barrow or Orion (Sheet 1 of 2)



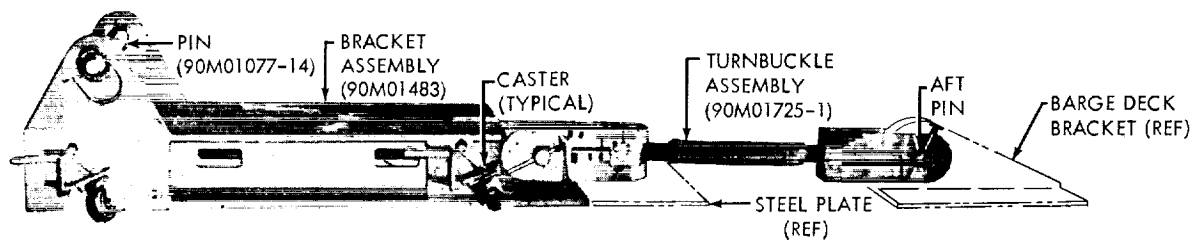
A

HUMIDITY CONTROL EQUIPMENT



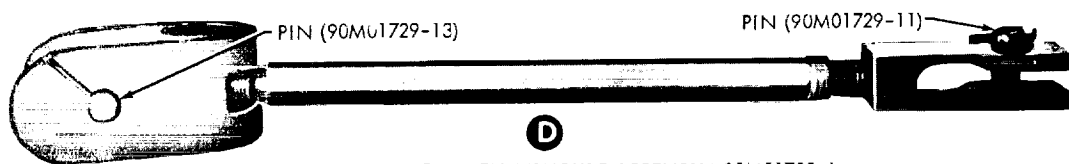
B

NITROGEN GAS SYSTEM



C

LONGITUDINAL TIE DOWN ASSEMBLY



D

LATERAL TIE DOWN TURNBUCKLE ASSEMBLY 90M01729-1

Figure 6-1. Barge Preparation and Checkout - Poseidon, Point Barrow or Orion (Sheet 2 of 2)

6-4. BARGE LOADING - POSEIDON, POINT BARROW OR ORION. Load S-IC stage and associated equipment on barge per figure 6-2 as follows:

- Verify that barge preparation and checkout has been accomplished per paragraph 6-3.
- Position any designated associated equipment or cargo forward of the A-frame assembly and tie down with barge furnished chains and load-binders per loading plan provided by the NASA loading officer.
- Roll the stage onto the barge, flight attitude forward, stopping movement aft of the longitudinal tie down bracket.

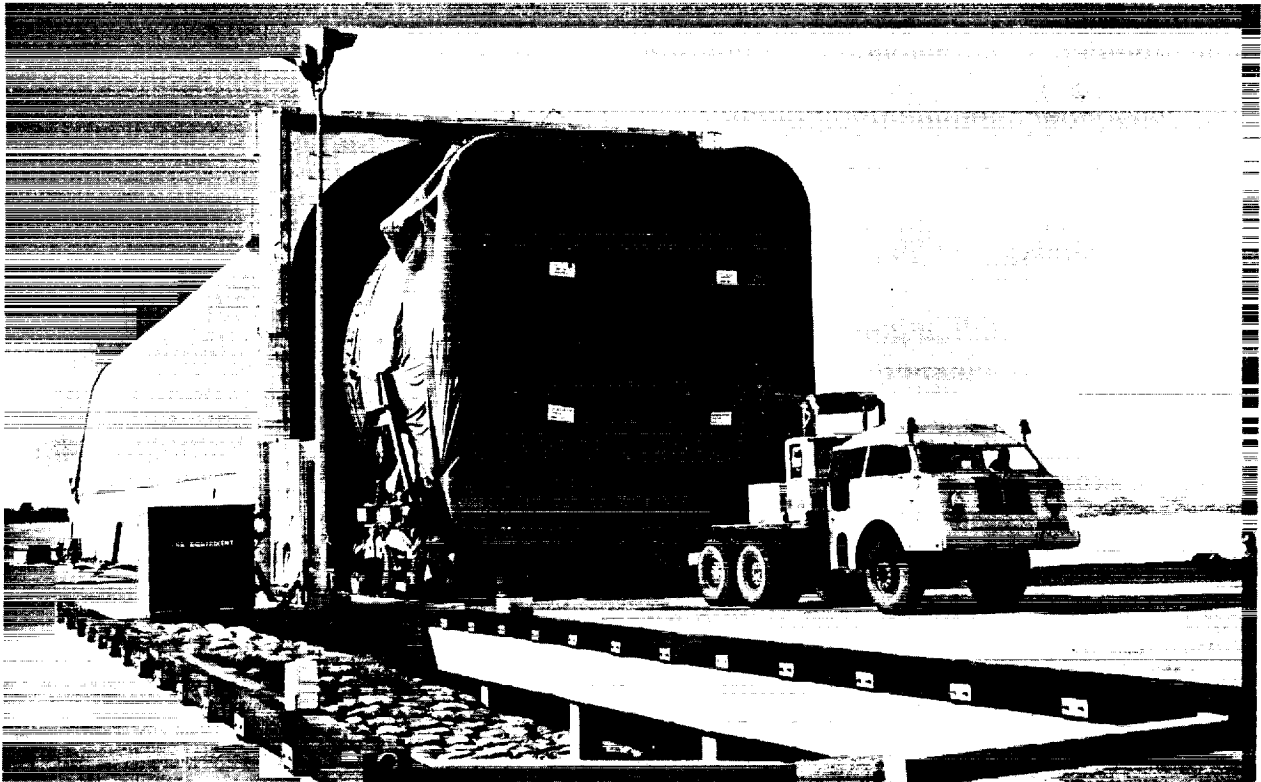


Figure 6-2. Barge Loading - Poseidon, Point Barrow, or Orion (Sheet 1 of 4)

- d. Raise the stage to the high position to allow clearance of the front dolly lateral beams and the longitudinal tie down bracket.
- e. Move stage forward and observe a vertical alignment between the longitudinal tie down assembly and center longitudinal beam of the front dolly.
- f. Lower stage, maintaining a dimension of 40 inches between stage and barge deck.
- g. Align the longitudinal tie down bracket and the longitudinal center beam of the front transporter dolly.
- h. Install pin (90M01077-14) (figure 6-1, detail C) connecting the longitudinal tie down bracket to the center beam of the front transporter dolly and remove casters from bracket.
- i. Install lateral turnbuckles (90M01729-1) to the front transporter dolly per figure 6-2, detail A.
- j. With the stage located and pinned longitudinally, but with the lateral turnbuckles loose, proceed with A-frame attachment.
- k. Release locking mechanism on A-frame boom 90M01889 so it can be moved aft.

WARNING

Never allow A-frame boom to move past 20° from vertical position indicated by red paint or red mark on winch cable. Loading on winch/cable would exceed design limits. Personnel injury and/or stage damage could occur.

1. Use the hand winch to actuate the boom which positions the A-frame for pin installation of the A-frame to the handling ring on the S-IC stage.

NOTE

Vertical adjustment may be made by raising or lowering the rear dolly. Lateral adjustment to starboard may be made by raising the left beam of front dolly and lowering the right beam of the front dolly. Port lateral adjustment is made opposite to starboard adjustment.

CAUTION

This method of alignment can be used only for minor adjustment.

- m. When alignment is complete, insert the A-frame pin 90M01077-14 through handling ring eye until it bottoms out (figure 6-2, detail D).
- n. When pin-up is completed, the winch must be in free running position.
- o. Remove aft pin of longitudinal tie down turnbuckle from barge deck bracket per detail B.
- p. Lower front dolly until the forward section of longitudinal tie down bracket is touching the barge deck.

CAUTION

Do not allow front lateral beam to rest on longitudinal tie down assembly. Observe closely while next operation is performed.

- q. Remove the weight from the rear dolly by releasing hydraulic pressure on wheel units of rear dolly. This allows the stage to center itself on the vessel and drive longitudinal bracket against the 1 1/2" steel plate on barge deck (figure 6-2, detail C). Turn wheel units ten and eleven to 90°.
- r. Replace aft pin of longitudinal tie down turnbuckle to barge deck bracket and tighten all longitudinal and lateral turnbuckles to remove slack.
- s. Position the front dolly support stands, front 90M01744-1 and rear 90M01744-3, adjust support stands to engage transporter and lock in position.

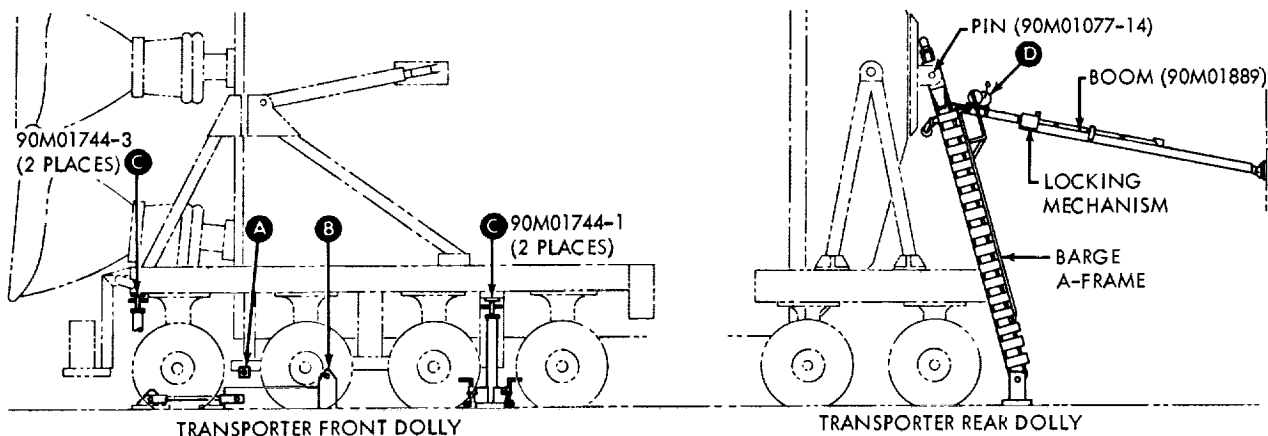
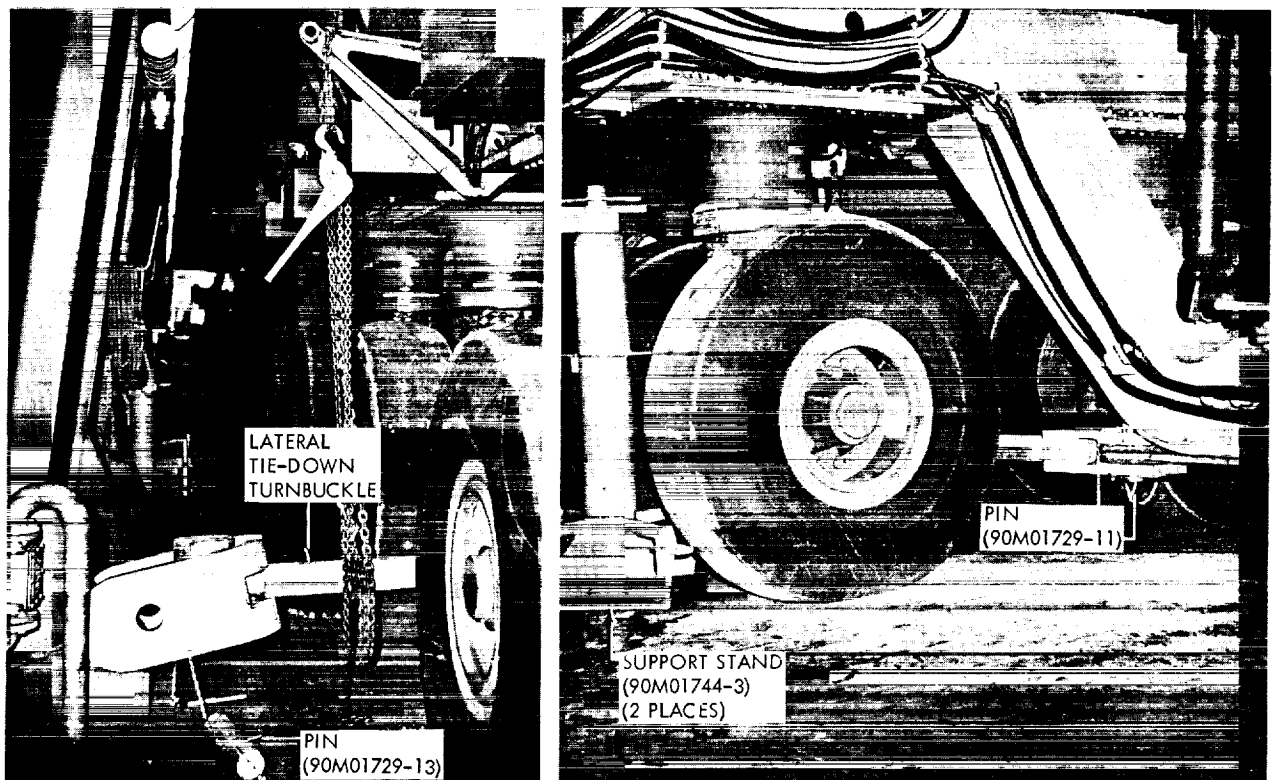
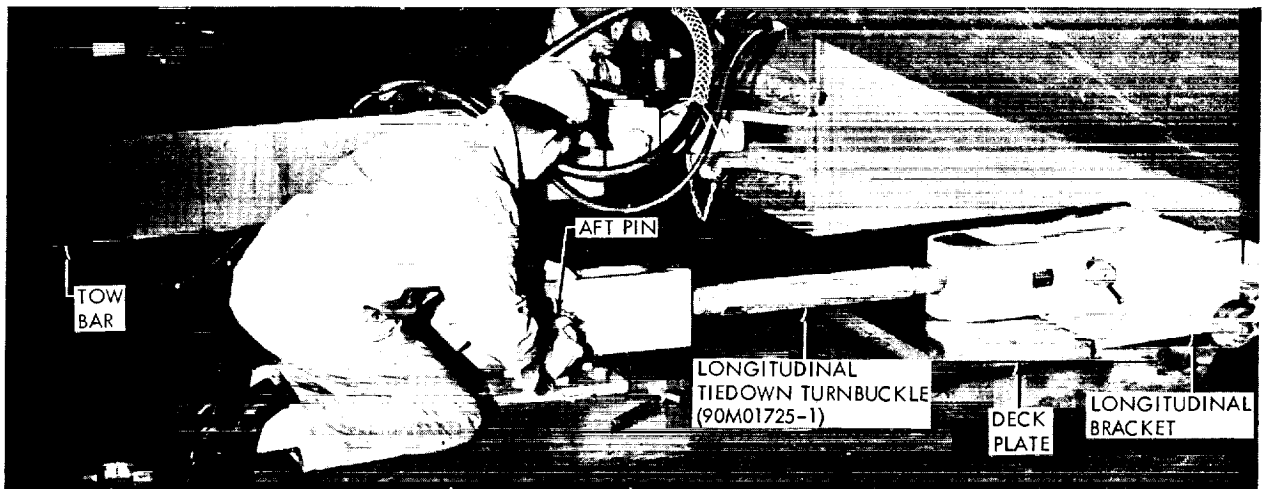


Figure 6-2. Barge Loading - Poseidon, Point Barrow, or Orion (Sheet 2 of 4)



A

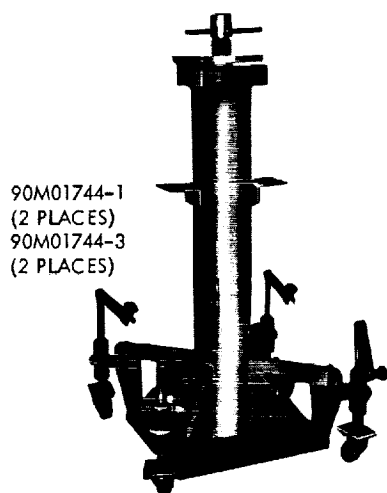
LATERAL TIE DOWN TURNBUCKLE INSTALLATION



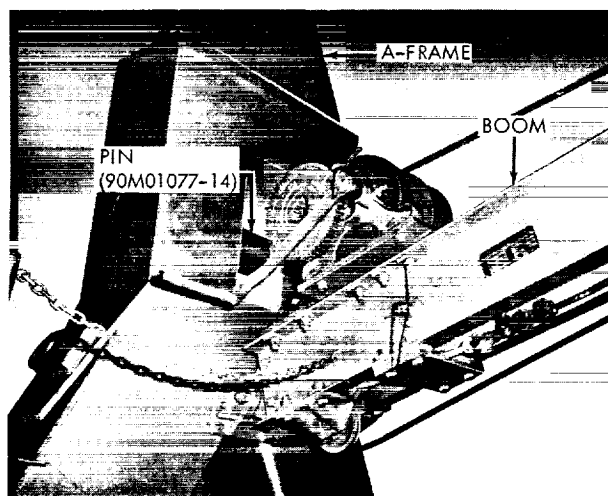
B

LONGITUDINAL TIE DOWN TURNBUCKLE - AFT PIN REMOVAL

Figure 6-2. Barge Loading - Poseidon, Point Barrow, or Orion (Sheet 3 of 4)

**C**

STAND ASSEMBLY

**D**

A-FRAME HAND WINCH

Figure 6-2. Barge Loading - Poseidon, Point Barrow, or Orion (Sheet 4 of 4)

- t. Remove weight from wheels by releasing hydraulic pressure from wheel units on front dolly. This insures that the A-frame pin 90M01077-14 is not loaded with a vertical load from dolly.
- u. Check all turnbuckles and adjustable stands and tighten to remove slack.
- v. Transfer tank pressure control and monitor unit and data recorder power supply cables from transporter to barge 115 vac supply.
- w. Connect barge nitrogen supply to tank pressure control and monitor unit 150 psig supply port on the gas storage module.
- x. Disengage and remove M26-A1 prime mover from barge.
- y. Shutdown transporter per paragraph 3-15, steps "c" through "o".
- z. Connect humidity control ducts to S-IC stage thrust structure and the forward skirt.
- aa. Lower tow-bar to barge deck, placing wooden block between barge and deck.
- ab. Secure tow-bar with chain and load-binder.
- ac. Transfer pitch/roll module LAS 4013376-3 from S-IC transporter aft dolly per paragraph 4-8 to top center beam of barge and tape in place.
- ad. Remove actuator jacks from transporter (4 places) and tie down to barge deck using wooden blocks as dunnage or stow in transporter equipment dolly. If stored on barge deck, secure with chains and load-binders.
- ae. Secure ship-loose items as required.
- af. Secure handles of load-binders with wire wraps.
- ag. Remove all associated equipment not required for marine shipment.
- ah. Assist barge crew in closing and securing doors.
- ai. Secure operation.

6-5. BARGE PREPARATION AND CHECKOUT - LITTLE LAKE AND PEARL RIVER. Prepare and checkout barges as follows:

- a. Verify barge electrical supply is operating properly at 115 (\pm 10) vac.
- b. Verify barge nitrogen supply is operating properly at 150 (\pm 10) psig and that the storage bottles are filled.
- c. Install longitudinal tie down fixture (90M01425-1) to the barge deck on the longitudinal center line at barge frame 16. Use 32 ASTM-A325 bolts.
- d. Checkout operation of longitudinal tie down fixture.
- e. Checkout operation of lateral tie down fixtures.
- f. Pre-positioned longitudinal and lateral tie down fixtures.

6-6. BARGE LOADING - LITTLE LAKE OR PEARL RIVER. Load S-IC stage and associated equipment on barge per figure 6-3 as follows:

- a. Verify that barge preparation and checkout have been accomplished per paragraph 6-5.
- b. Check installation of longitudinal tie-down bracket (90M01425-1) at barge frame 16.
- c. Load three engine extensions (209210, vendor code 02602) on starboard side and two on the port side of longitudinal center-line between barge frames 12 and 14.
- d. Install four chain assemblies and load binders between engine extensions and "D" rings mounted on barge deck.
- e. Position S-IC stage with engine end toward the bow of the barge. Align longitudinal center line of stage to longitudinal center line of barge.

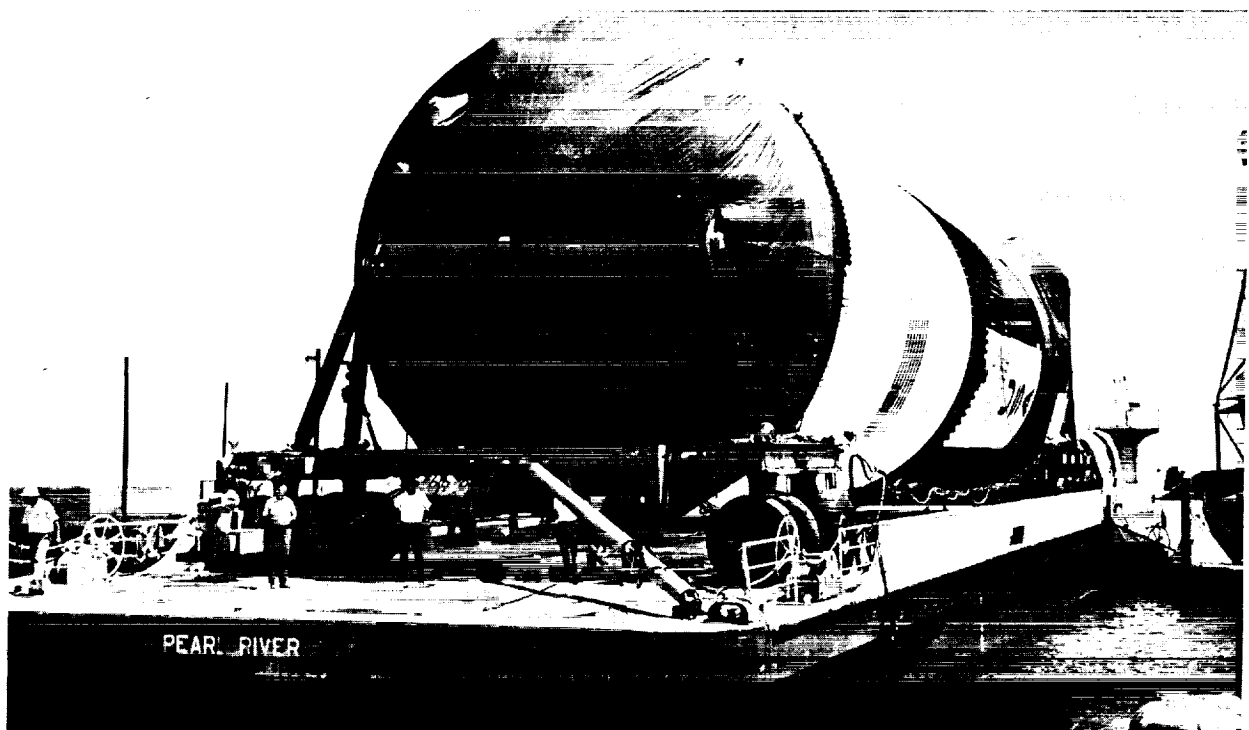


Figure 6-3. Barge Loading - Little Lake or Pearl River

- f. Using the transporter hydraulic system, raise stage to clear tie-down.
- g. Stop stage movement aft of tie-down bracket (90M01425-1) at barge frame 16.
- h. Install pin assembly (90M01425-9) in longitudinal center beam of transporter.
- i. Move transporter to properly align pin assembly (90M01425-9) and longitudinal center beam of transporter over tie-down bracket (90M01425-1).
- j. Install bracket (90M01974-5) to the right and left tie-down brackets located on the front lateral beam of front dolly using lock pin assembly (90M01974-17).
- k. Using the transporter hydraulic system, lower stage to mate pin assembly (90M01425-9) in center of tie-down bracket (90M01425).
- l. Lower stage until front dolly center longitudinal beam is 12 inches from barge deck.
- m. Measure to assure that front dolly right and left beam struts are of the same height.
- n. Install a pair of turnbuckles G-227 and 12" steamboat rachets between the tie-down brackets (90M01974-5) installed by step "j" and the barge deck tie-downs (90M02025). Tighten to remove slack.
- o. Install a bracket (90M01974-3) to each side of the rear dolly lateral beam with bolts and lock washers.
- p. Attach a pair of 7 foot cables and 30" steamboat rachets to each bracket (90M01974-3) and barge deck "D" rings.
- q. Tighten to remove slack on each of the four tie-down cables.
- r. Transfer tank pressure control and monitor unit and data recorder power supply cable from S-IC transporter to barge 115 vac supply.
- s. Set steering made switch (9) per figure 3-5 to parallel and rotate one wheel unit each side of rear dolly per figure 6-3.
- t. Disengage and remove prime mover from transporter and barge.
- u. Shutdown transporter per paragraph 3-15, steps "c" through "o".
- v. Rotate tow bar to starboard side of barge and fasten to barge deck.

6-7. BARGE S-IC ENVIRONMENT CONTROL AND DATA EQUIPMENT - ACTIVATION. Connect and activate equipment as follows:

- a. Transfer power supply for tank pressure control and monitor unit and data recorder equipment from transporter to 115 vac barge supply.
- b. Install hose from barge gas supply 150 psig to gas storage module.
- c. Purge hose and connect to gas storage module 150 PSI FACILITY SUPPLY (25) per figure 3-7.
- d. Verify 150 (\pm 10) psig on SUPPLY PRESSURE gage (2) per figure 3-7.
- e. On barges Poseidon, Point Barrow, or Orion, fasten pitch and roll module to support beam of barge roof with tape.
- f. On barges Little Lake or Pearl River, fasten pitch and roll module to center line of barge.
- g. Install ducts from barge desiccant equipment to forward skirt area and thrust chamber area.

6-8. BARGE ENROUTE S-IC TANK PRESSURE AND TRANSPORTATION DATA MONITORING. Monitor and equipment and record data while barge is enroute as follows:

- a. Verify every hour that tank pressure control and monitor unit is operating properly and tanks are maintained at 4 (± 1) psig.
- b. Verify and record data every hour that recording equipment is functioning properly and sufficient paper is available in both recorders.
- c. Reload oscillograph paper every 48 hours of operation.

6-9. BARGE UNLOADING - POSEIDON, POINT BARROW, OR ORION. Unload S-IC stage from transporter and associated equipment as follows:

- a. Verify that M26-A1 prime mover checkout was accomplished per paragraphs 3-8 and 3-9.
- b. Checkout transporter per paragraph 3-10.
- c. Assist barge crew in opening and securing barge doors.



Turnbuckles must be disconnected as outlined in steps "d" and "e" to provide adequate overhead clearance for stage off-loading.

- d. Loosen and disconnect ten (10) barge door turnbuckles at the wonder building attachment points. Swing turnbuckles so that they hang vertically along inboard sides of doors.
- e. Loosen and disconnect one (1) barge door turnbuckle (third inboard from port side) at the door attachment point. Remove turnbuckle barrel from wonder building end of turnbuckle clevis and secure barrel on access platform.
- f. Remove door locking handwheels and stow in pipe brackets located on starboard door.
- g. Disconnect four (4) deck turnbuckles and remove deck hold-down bolts on the port and starboard door support frames.

NOTE

Do not disconnect center door support frame prior to barge docking.



Leave sufficient S-IC cargo tie-downs in place so as to prevent inadvertent shifting of cargo under unpredicted or adverse conditions.

- h. Remove the two (2) turnbuckles and remove deck hold-down bolts on the center barge door support frame.
- i. Position barge stern door dollies and open and secure the stern doors, utilizing a 15,000 pound forklift.
- j. Remove partial S-IC stage cargo tie-downs, S-IC transporter tow-bar, and other miscellaneous shipping cargo.
- k. Rearrange cargo against wonder building port and starboard bulkheads and under S-IC transporter to provide clearance for ease of removal of the stage and cargo.
- l. Remove three (3) barge stern door supports from barge utilizing a 15,000 pound forklift and stow on dock in such a manner so as to permit equipment freedom of movement.

- m. Remove barge stern door access step and stow on dock clear of working area. Remove any cargo from barge aft-cargo area and load on flat bed trailer.
- n. Remove cargo off-loaded previously to storage area and return flat bed trailers to standby locations.
- o. Clear the aft end of the cargo hold area of any tie-downs, dunnage, tools, etc., and stow clear of the work area against the barge port and starboard bulkheads.
- p. Attach M26-A1 prime mover to S-IC stage transporter per paragraph 3-11.
- q. Perform checkout of prime mover and transporter per paragraph 3-12.



Do not rotate wheel units until tie-down equipment is removed.

- r. Actuate the left and right beam unit power circuit breakers on both front and rear dollies located in distribution boxes.
- s. Loosen two (2) lateral turnbuckle tie-down assemblies (90M01729-1).
- t. Loosen one (1) longitudinal turnbuckle tie-down assembly (90M01725-1).
- u. Raise transporter dollies as required to remove and/or disconnect two (2) each stand assemblies (90M01744-1) and (90M01744-3), one (1) longitudinal turnbuckle tie-down assembly (90M01725-1), two (2) each lateral turnbuckle tie-down assemblies (90M01729-1), and one (1) A-frame pin (90M01077-14) as follows:
 - (1) Open all one (1) inch valves above all wheel units.
 - (2) Verify all small valves in each hydraulic control package are in the neutral position.
 - (3) Open shutoff valve at each hydraulic control package.
 - (4) Close the by-pass valve at each hydraulic control package.
 - (5) Start pump motors.
 - (6) Displace leveling valves to "pressure" or "up" position.

NOTE

Front dolly leveling valves should be operated simultaneously in order to prevent binding lateral and longitudinal tie-down pins.

If it is necessary to lower dollies proceed to step "w".

- v. Return the leveling valves to the neutral position and stop pump motors when dollies reach the desired height. Place the leveling valves in the "return" or "down" position to lower.

NOTE

Pump motors need not be running to lower dollies.

- w. Return the leveling valves to the neutral position when the dollies reach the desired height.
- x. Remove support stands and store along port and starboard bulkhead.
- y. Adjust rear dolly to allow removal of an A-frame pin from the forward handling ring lifting eye. Adjustment is obtained by using hydraulic system of rear dolly.
- z. Remove A-frame pin from the forward handling ring lifting eye.

- aa. Use the hand winch to move the A-frame forward. Actuate winch locking mechanism to lock A-frame in vertical position after A-frame clears stage.
- ab. Raise stage to sufficient height to allow removal of lateral tie-down assembly from the transporter lateral tie-down.
- ac. Remove lateral tie-down assemblies and store in a location clear of the stage roadway.
- ad. Disconnect barge de-humidifier equipment at forward skirt and thrust structure sections and stow flex ducts.
- ae. Remove gas and electrical supply for tank pressurization and control equipment from barge supply. Utilize transporter electrical supply and gas storage module supply per paragraph 5-7, and place in transport operation.
- af. Transfer data monitor power cable from barge electrical supply to transporter supply per paragraph 5-7.
- ag. Remove pitch and roll module of data monitor from support beam of barge roof and fasten to front beam of transporter per paragraph 4-9, step "e", (8).
- ah. Raise front dolly as required to clear longitudinal turnbuckle tie-down bracket (90M01483) during transporter movement from the barge.
- ai. Verify that transporter is in readiness for towing from the barge and barge is secured and ballasted for load transfer.
- aj. Tow the transporter and S-IC stage off the barge per figure 6-2, sheet 1.

6-10. S-IC STAGE BARGE UNLOADING - LITTLE LAKE OR PEARL RIVER. Unload S-IC stage and associated equipment from barge as follows:

- a. Remove chains and load-binders from associated equipment.
- b. Remove associated equipment from stern of barge and store away from the S-IC stage roadway.
- c. Checkout transporter and prime mover per paragraphs 3-8 through 3-10.
- d. Attach M26-A1 prime mover to S-IC transporter per paragraph 3-11.
- e. Remove turnbuckles and steamboat ratchets from the front dolly right and left lateral tie-down brackets.
- f. Remove cable assemblies and steamboat ratchets from brackets (90M01974-3) on the rear dolly.
- g. Remove brackets (90M01974-3) from the rear dolly lateral beam.
- h. Perform checkout of transporter and M26-A1 prime mover per paragraph 3-12.
- i. Using hydraulic system, raise stage to clear pin assembly (90M01425-9) from tie-down bracket (90M01425-1).
- j. Remove pin assembly (90M01425-9) from front dolly center longitudinal beam.
- k. Remove bracket assembly (90M01425-5) from right and left tie-down brackets located on the front lateral beam of front dolly.
- l. Transfer power cables of the tank pressure and control equipment and data recorder from barge supply to S-IC stage transporter supply per paragraph 5-7.
- m. Disconnect barge gas supply from tank pressure and control equipment and rig for operation with gas storage module per paragraph 5-7.
- n. Assure that barge is ballasted properly to allow removal of stage.
- o. Tow transporter and S-IC stage off the barge.

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SECTION VII

S-IC STAGE TRANSPORTER UNLOADING

7-1. GENERAL

7-2. This section provides procedures for removing S-IC stage from the transporter where a dual overhead crane system is available. Attachment of forward lifting linkage and aft rotational brace are covered in Sections IV, VIII, IX, and X depending on location.

7-3. S-IC STAGE AND TRANSPORTER DISCONNECT. Disconnect the S-IC stage from the transporter as follows:

- a. Remove fore and aft covers in reverse order of installation per paragraphs 4-11 and 4-12.
- b. Remove data recorder and sensors in reverse order of installation per paragraph 4-9.
- c. Attach crane hooks to forward lifting linkage and aft rotational brace per paragraph 4-4.
- d. Place a slight tension on both the forward and aft bridge crane hooks.
- e. Loosen tension on steel messenger wire by releasing hand winch located on right side of rear dolly.
- f. Detach one forward lateral turnbuckle assembly (90M00514) from the stage handling fittings at Position I, on the front dolly transverse beam per figure 4-5.
- g. Detach one rear lateral turnbuckle assembly (90M00427) per figure 4-6.
- h. Close hydraulic hand valve above all wheel units.
- i. Detach two connecting linkage assemblies (90M01715) per figure 4-5, detail A from stage handling fittings at station 280, Positions II and IV, utilizing special spanner wrench (SK-BMS-104).



Attach the 12-ton mobile crane to each linkage assembly in order to support the weight during removal. Forklifts with man platforms will be used to provide access. Men on platforms will be equipped with safety belts.

- j. Remove one rear longitudinal tie pin (90M00598) from bracket assembly (90M00594) on rear dolly lateral beam per figure 4-6, detail B.
- k. Install four electric actuator jacks (90M01655) on A-frames on transporter.
- l. Remove two rear trunnion support caps (90M00408) and U-bolts from S-IC stage and transporter per figure 4-6.
- m. Remove two pins (90M00396) connecting forward A-frames to stage handling fittings at station 115, Position II and IV per figure 4-5.
- n. Move the forward and aft stage support structure (A frames) away from the S-IC stage using electrical actuator jacks (90M01655) or a mobile crane with a steel cable attached to A-frame head.
- o. Remove the two remaining front and rear turnbuckle assemblies.
- p. Install hand crank on jack screw (figure 4-5) and turn counterclockwise to release pressure on stage.

- q. Insure adequate clearance between S-IC stage and jack screw assembly on forward dolly.

CAUTION

Do not hoist until tank pressurization system has been disconnected and removed.

- r. Disconnect S-IC stage tank pressurization and control lines from tanks per paragraph 7-4, steps "a" and "d".
- s. Hoist S-IC stage away from transporter.

7-4. S-IC STAGE TANK PRESSURIZATION SYSTEM DISCONNECT. Verify tank pressures are 4 (± 1) psig and remove equipment and cap as follows:

CAUTION

Cap all fittings and plug all hoses to maintain LOX cleanliness.

- a. Disconnect LOX and fuel tank pressurization lines from stage, cap stage fittings per figure 4-8.
- b. Disconnect sense lines from stage, cap connections per figure 4-8.
- c. Disconnect LOX and fuel tank pressurization and sense lines from tank pressurization and control equipment.
- d. Disconnect tank pressure and control equipment from nitrogen supply.
- e. Remove from transporter rear dolly in reverse order of installation per paragraph 4-8.

SECTION VIII

S-IC STAGE TRANSPORTING AND HANDLING AT MICHLOUD ASSEMBLY FACILITY

8-1. INTRODUCTION.

8-2. This section provides procedures for handling the S-IC stage in the vertical assembly building (VAB), the horizontal assembly area and transporting between other locations at the Michoud Assembly Facility.

8-3. S-IC STAGE HANDLING VAB - REMOVAL. Remove S-IC stage from vertical position in VAB and load in transporter as follows:

CAUTION

This operation is sensitive to wind conditions. Do not undertake task when winds and gusts of more than 15 knots are predicted. The S-IC tanks are pressurized before disconnecting the pressure system to compensate for any leakage during removal from VAB.

- a. Assure that transportation equipment has been checked out per Section III.
- b. Attach rotation brace assembly (65B61115-1) to adjustment linkage assembly (65B61114-1).
- c. Hoist the combined rotation brace assembly (65B61115-1) and adjustment linkage assembly (65B61114-1) to position III on the aft end of the S-IC stage and attach to the three (3) stage handling fittings per figure 4-3. Use previously installed 3 inch pins (75M51020-6 (2) and 75M51020-5) and pin puller (75M51012-4).
- d. Remove pin pullers (75M51012-4) and pin retainer clamp assembly (75M51023-13). Install retainer plates (75M51023-10) in pin retainer clamp assemblies (75M51023-13) and install to retain pins.
- e. Disconnect adjustment linkage assembly (65B61114-1) from rotation brace assembly (65B61115-1) and remove from stage.
- f. Attach prime mover and the 15 foot tow bar on rear transporter dolly and position in center aisle of VAB, on guide lines provided, approximately 150 feet east of fixed hinge.
- g. Attach second prime mover and 30 foot tow bar to front transporter dolly and position outside the west door of VAB on guide lines provided.

WARNING

All personnel working from suspended scaffolding or platforms, open structures outside of areas protected by handrails, ladders, buildup scaffolding or extendible platforms more than 20 feet above ground or elevated deck levels, ladders or scaffolding with overturning radii beyond the protection of deck level handrails, or cherry pickers shall wear safety belts. Soft soled shoes and safety belts are mandatory for all personnel working on S-IC stage.

- h. Position a Lift-A-Loft in east end of VAB with one set of rear transporter dolly trunnion caps, "U" bolts, and nuts in basket.
- i. Position 6,000 pound forklift truck with personnel stand in east end of VAB with one set of rear transporter dolly trunnion caps, "U" bolts and nuts in basket.
- j. Position Lift-A-Loft at west end of VAB with a four foot web belt, four inches in width, and web strap wrench in basket.

- k. Position cherry-picker with basket outside west door of VAB.
- l. Position cherry-picker with hook outside west door of VAB.
- m. Attach prime mover with 30 foot tow bar to front transporter dolly and make air and electrical connections.
- n. Attach prime mover with 15 foot tow bar to rear transporter dolly and make air and electrical connections.
- o. Position 5-1447 tool box in an area that is readily available.
- p. Clear outside roadway to allow clear stage travel.
- q. Install forward lifting linkage (65B61112-1) to 180 ton overhead hoist using pin (65B61118-1) previously installed in forward lifting linkage.
- r. Position overhead hoist with forward lifting linkage over vertical S-IC stage assembly.
- s. Verify that rotational brace (65B61115-1) is properly installed on the stage.
- t. Check stage forward handling ring eye for burrs. Grease inside bearing surface of eye with Texaco Marfax All-Purpose grease.
- u. Hoist forward lifting linkage (65B61112-1) clear of stage, then align over stage and attach to stage forward handling tool lifting eye. Use previously installed 5 1/2 inch pin (65B61120-1) and pin puller assembly (65B61113-1).
- v. Remove pin puller (65B61113-1) and pin retainer clamp assembly (65B61122-1). Install retainer plate (65B61121-1) in pin retainer clamp assembly (65B61122-1) install to secure pin (65B61120-1).
- w. Clear VAB center aisle of all personnel.
- x. Perform operational check of all team member two-way radios.
- y. Attach a guide line to the stage servoactuator strut at each outboard engine position.
- z. Instruct hoist operator to raise stage slowly. Adjust bridge and trolley as required for proper alignment.
- aa. After stage is clear of pylons, travel west with stage.
- ab. Remove stage from tower to center of aisle and lower to within three feet of floor.
- ac. Rotate stage clockwise to align rotational brace on the S-IC stage with the fixed hinge attached on cables to the west door frame.
- ad. Remove guide lines from positions B and C.
- ae. Raise stage to the height required to mate the rotational brace to the fixed hinge. Use guide lines to maintain alignment.
- af. Two men will use cherry-picker with basket or suitable equipment to attach rotational brace to fixed hinge.

NOTE

Take fixed hinge control panel in basket.

- ag. Perform operational check of the fixed hinge for pin insertion, removal and locking. Position the fixed hinge cylinder in full up position.
- ah. Attach the rotation brace (65B61115-1) to the fixed hinge. Use previously installed 4 1/2 inch pin (65B61133-1) and pin puller (65B61123-1).
- ai. Remove the pin puller (65B61123-1) and pin retainer clamp assembly (65B61122-1). Install retainer plate (65B61121-1) in pin retainer clamp assembly (65B61122-1) and install to secure pin (65B61133-1).
- aj. Lock out controls. Power to the hydraulic system of the fixed hinge is to stay ON.

ak. Position hooktenders 90° to the fixed hinge and at forward end of stage with radio communications.

WARNING

Hooktenders will assure that laydown area remains free of personnel during laydown and activate the emergency stop button located on tower elevator to remove hoist power if required.

- al. Lower the stage slowly, moving hoist slowly eastward per figure 8-1. Personnel at the fixed hinge position will maintain the hinge cables in a vertical attitude. As the stage is lowered, a hooktender at the forward end of the stage will assist in maintaining vertical alignment of the hoist cables until stage is in level horizontal position.
- am. Lower stage to 44 inches from the floor using the fixed hinge aft and the overhead hoist forward to achieve trunnion alignment of the transporter rear dolly.
- an. Position a team member with radio at the fixed hinge pendant control until transporter attachment is completed per paragraphs 4-5, 4-6 and 4-7.
- ao. Load transporter with S-IC stage per Section IV.
- ap. Disconnect aft rotation brace assembly in reverse order per "b" thru "e", "ah" and "ai" above.
- aq. Disconnect forward lifting linkage in reverse order per "q", "u" and "v" above.

8-4. S-IC STAGE HANDLING VAB - ERECTION. Erect S-IC stage in the VAB per figure 8-1 as follows:

CAUTION

This operation is sensitive to wind conditions. Do not undertake task when winds and gusts of more than 15 knots are predicted. The S-IC tanks are pressurized before disconnecting the pressure system to compensate for any leakage during erection.

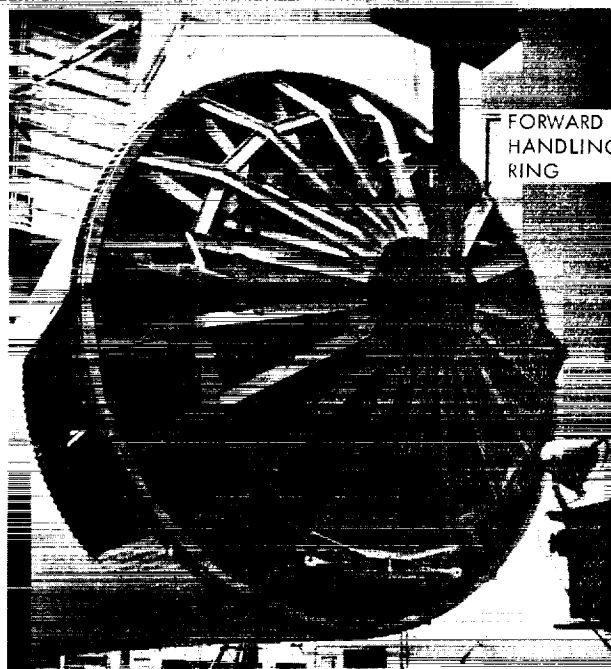
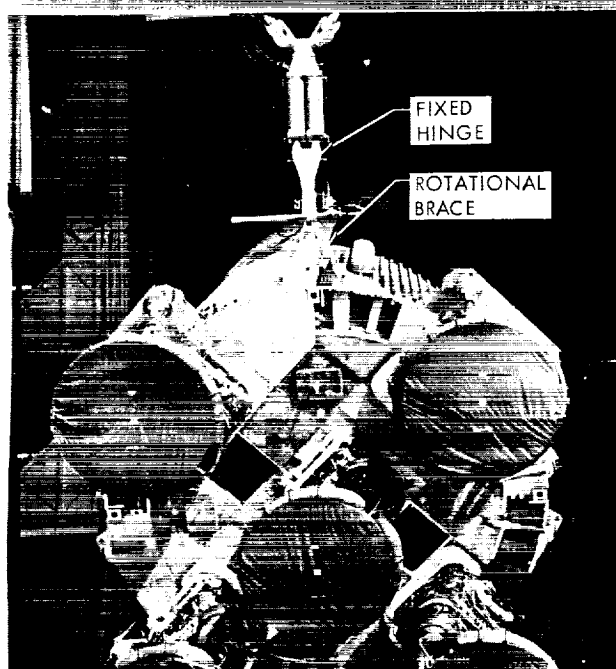
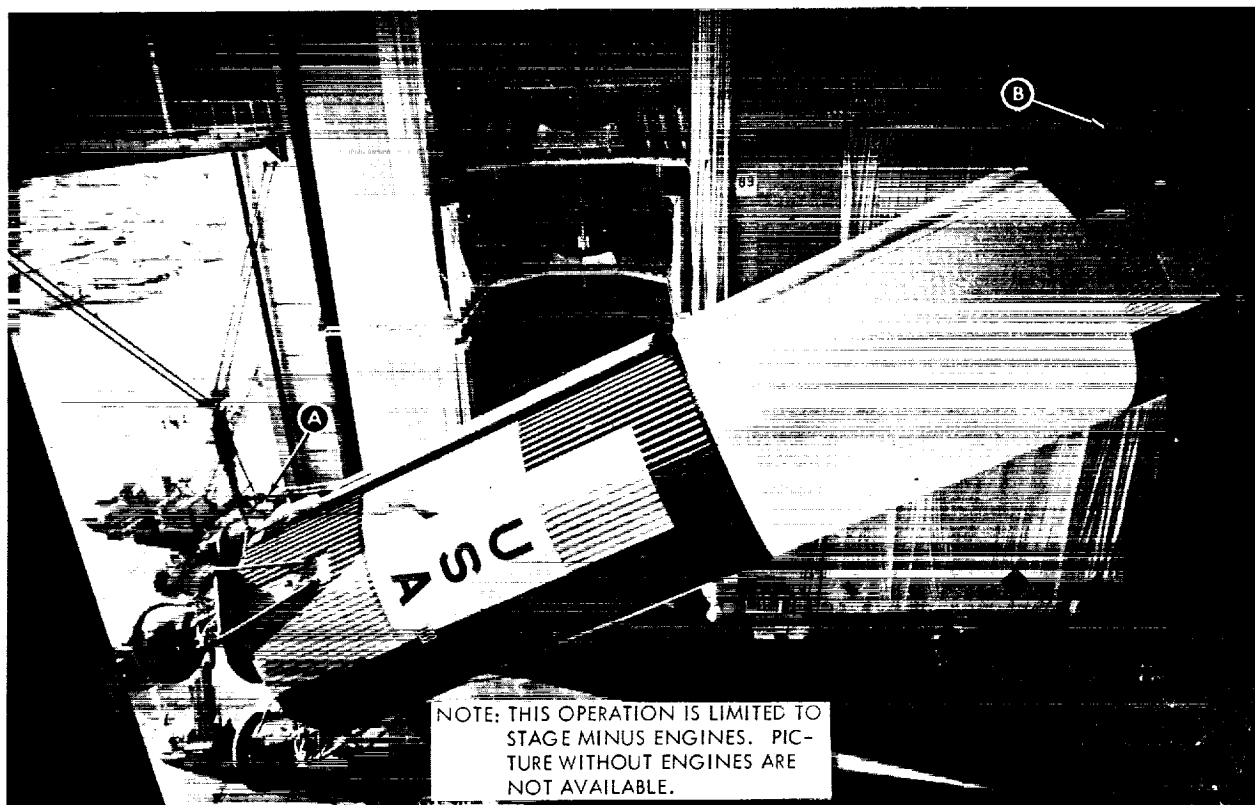
- a. Proof test the fixed hinge and overhead hoist.
- b. Checkout transporter per Section III.
- c. Tow S-IC and transporter into VAB per paragraph 5-9 and align S-IC stage center line with center line on VAB floor.
- d. Remove protective covers in reverse order of installation per paragraphs 4-11 and 4-12.
- e. Remove stage transportation instrumentation and recorder in reverse order of installation per paragraph 4-9.

WARNING

All personnel working from suspended scaffolding or platforms, open structures outside of areas protected by handrails, ladders, buildup scaffolding or extendible platforms more than 20 feet above ground or elevated deck levels, ladders or scaffolding with overturning radii beyond the protection of deck level handrails, or cherry-pickers shall wear safety belts. Soft soled shoes and safety belts are mandatory for all personnel working on S-IC stage.

- f. Remove anti-friction plates (60B19612-1) at Positions II, III, and IV as follows:

- (1) Break bond line with plexiglass chisel.



A

B

Figure 8-1. S-IC Stage Handling VAB - Michoud Assembly Facility

WARNING

Methylene chloride is a highly volatile non-flammable solvent. Keep away from heaters, flames or sparks; becomes highly toxic at high temperatures. Avoid skin contact and breathing of vapors; wear protective gloves and clothing. Use in adequate ventilated area, mechanically ventilate or use respiratory protection.

- (2) Remove old epoxy adhesive by soaking with methylene chloride - CAB-O-SIL gel.
- (3) Apply 1/4 inch thick layer of gel; scrape dissolved layer and renew every 30 minutes.
- (4) Prepare gel by adding CAB-O-SIL to methylene chloride until non-flowable.

CAUTION

Do not scratch aluminum surface. Use scotch-brite type A aluminum oxide abrasive for removing final layer of epoxy.

- (5) Optional method; abrasive clean per BAC 5748.
- g. Utilizing overhead hoist, pick-up, position, and attach rotational brace to the S-IC stage per paragraph 8-3.
- h. Position stage to maintain vertical alignment of rotational brace assembly to the fixed hinge.
- i. Using transporter hydraulic system, raise stage to a height not to exceed eighteen inches.
- j. Lower fixed hinge to a position to allow mating and attachment of the rotational brace assembly to the fixed hinge per paragraph 8-3.
- k. Utilizing cherry-picker with basket, raise two men to attach rotational brace to fixed hinge.

WARNING

Fixed hinge control panel will be taken with personnel in cherry-picker and personnel will wear safety belts while working from basket.

- l. Perform operation check of the fixed hinge for pin insertion, removal and locking.
- m. Attach rotational brace assembly to fixed hinge, insert pin and locking device per paragraph 8-3.
- n. Lock out controls by turning key switch on fixed hinge control panel to OFF position.
- o. Return personnel in cherry-picker to floor level.

NOTE

Operator of fixed hinge control panel must remain at panel station with power ON until the stage is removed from the fixed hinge.

- p. Check forward handling ring pick-up eye for burrs.
- q. Grease inside bearing surface of eye with Texaco Marfax All-Purpose grease.

- r. Attach forward lifting linkage to 180 ton overhead hoist per paragraph 8-3.
- s. Align overhead hoist and attach forward lifting linkage to stage forward handling ring.
- t. Clear VAB center aisle of all personnel and perform operational check on all two-way radios.
- u. Apply tension to the stage forward handling ring with 180 ton overhead hoist until wheel loading gage in the hydraulic power pack unit on the rear dolly reaches 200 pounds.
- v. Raise fixed hinge until the wheel loading pressure of the front dolly reaches 500 pounds.
- w. Continue to unload transporter per Section VII.
- x. Lower transporter front dolly to minimum height.
- y. Remove tank pressurization and control system from the stage and plug tanks in reverse order of installation per paragraph 4-8.
- z. Tow transporter rear dolly away to a position that will clear forward handling ring during stage rotation.
- aa. Raise stage in a horizontal plane using fixed hinge and forward overhead hoist until hydraulic cylinders of hinge are in full up position.
- ab. Remove anti-friction plate (60B19612-1) at position 1 per "f" above.
- ac. Tow transporter front dolly to apron west of vertical assembly building.
- ad. Position hooktenders 90° to the fixed hinge and at forward end of stage with radio communications. Connect guide lines to stage servoactuator struts at positions A and D.
- ae. Slowly raise the forward end of the stage and move the overhead hoist slowly westward until stage is in vertical position.

NOTE

Personnel at the fixed hinge position will maintain the hinge cables in a vertical attitude. Personnel at the forward end of the stage will maintain vertical alignment of the overhead hoist cables at all times.

- af. Prepare to disconnect the fixed hinge from the rotational brace by utilizing a cherry-picker with basket.

NOTE

Place the fixed hinge control panel with personnel in the cherry-picker basket.

- ag. Raise stage in micro speed with overhead hoist to remove stage load from fixed hinge.
- ah. Disengage fixed hinge from rotational brace per paragraph 8-3.
- ai. Slowly move hoist eastward to a point that will align stage with final assembly tower. Lower stage near floor level.
- aj. Rotate and align stage to assembly tower position.
- ak. Raise stage to height to allow structure to clear top of pylons.

CAUTION

Hooktenders will be positioned with radios to assure visual observances of the entire stage while positioning stage in assembly tower.

- al. Slowly move overhead hoist and position stage in the final assembly tower.

- am. Lower the stage at micro speed to resting position on pylons.
- an. Connect S-IC tank pressurization and control equipment.
- ao. Remove forward lifting linkage and hoist from the forward handling ring per paragraph 8-3.
- ap. Remove aft rotational brace per paragraph 8-3.

8-5. S-IC STAGE TRANSFER FROM TRANSPORTER TO STORAGE STANDS. Transfer the S-IC stage from transporter to storage stands (90M01961-1 and 90M01970-1) as follows:

- a. Assemble tower assembly (90M01956-5) in vertical position with pinned platform in raised position.
- b. Pinned platform to be in raised position.
- c. Install short head assembly (90M01956-7) to the tower assembly. Torque bolts to 300 (\pm 10) foot-pounds.
- d. Establish a center line in stage storage areas for longitude and lateral planes.
- e. Lay neoprene rubber pads (90M01956-203) on storage area floor. Locate pad centers at 49 feet 10 (\pm 1/2) inches on stage aft end lateral center line, centered around longitudinal center line.
- f. Assure that the notches in the neoprene pad are in correct orientation for the tension ties.
- g. Level pad locations to \pm 1 inch by use of steel plates.
- h. Set the A-frame assembly (90M01956-3) on the neoprene rubber pads per figure 8-2.

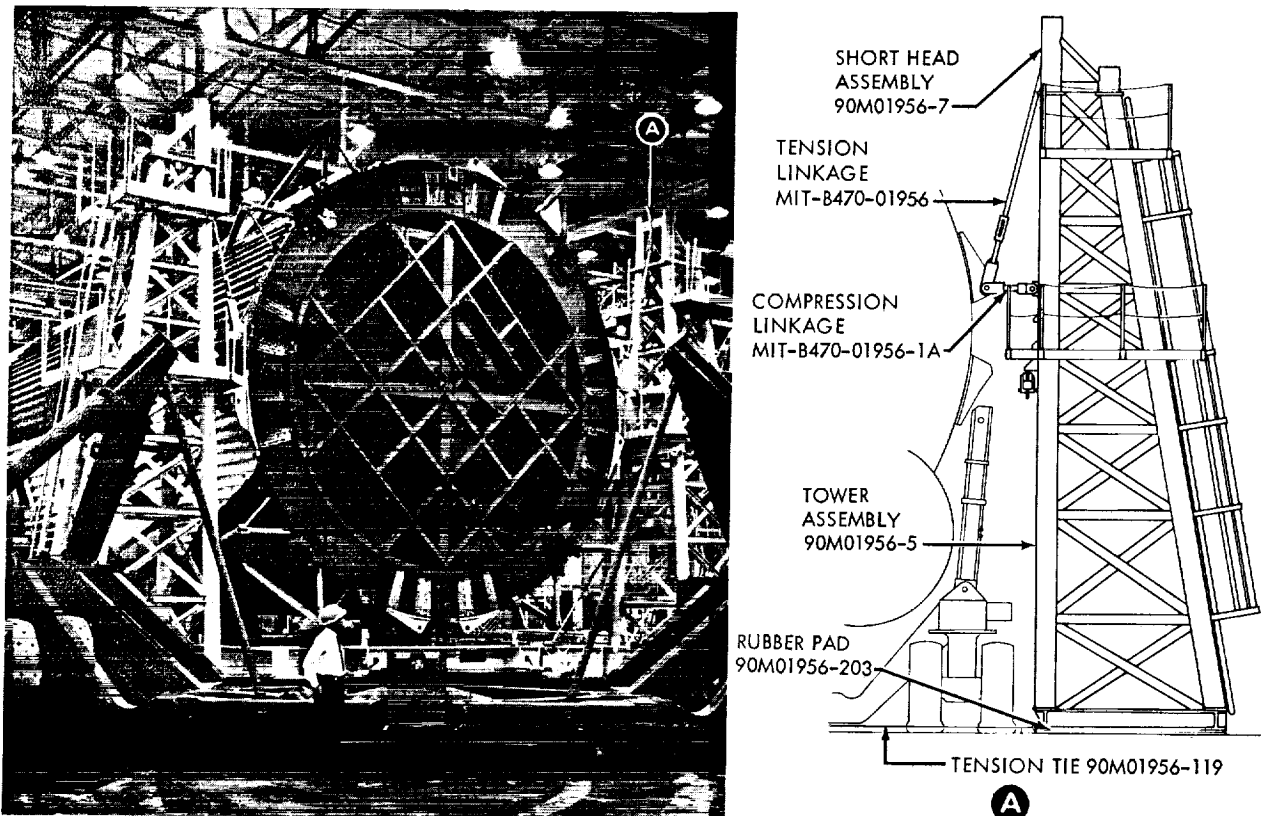


Figure 8-2. S-IC Transfer "A" Frame - Utilization

- i. Attach compression linkage MIT2-B470-01956-1A to tower. Suspend from a "come-a-long" to allow vertical adjustment.
- j. Attach tension linkage assembly MIT-B470-01956 to short head assembly (90M01956-7).
- k. Adjust tension linkage MIT-B470-01956 to 155 inches.
- l. Verify distance between the opposing legs as 41 feet 3/4 inches $\pm 1/2$ inch measured center of leg to center of leg.
- m. Tow transporter with the S-IC stage into position. Center over lines established per step "d".
- n. Attach cable assemblies (90M01956-119) to the towers and take up the slack after MZ6-A1 prime mover has passed but before transporter passes between towers.
- o. Position timber blocks (90M01956-117) under cable assemblies in line with transporter wheels but clear of cable clamps.
- p. Position the S-IC stage and transporter between towers.
- q. Using transporter hydraulic system, raise stage to within 2 inches of maximum height.
- r. Lower pinned platform. Install safety rails.
- s. Attach tension linkage assembly (MIT-B470-01956) to the S-IC stage using pin (90M01956-113), to temporarily hold the linkage assembly.
- t. Attach compression linkage assembly (MIT2-B470-01956-1A) to S-IC stage by slipping assembly over tension linkage assembly (MIT-B470-01956) and inserting pin assembly (90M01956-97) and driving out pin (90M01956-113).
- u. Remove all slack from linkage assembled (MIT-B470-01956 and MIT2-B470-01956-1A) with maximum distance between ends of compression linkage not to exceed 10 inches.
- v. Tighten lock nuts on compression linkage (MIT2-B470-01956-1A) to 7 1/2 ($\pm 2 1/2$) foot-pounds.
- w. Install cotter pins in the tension linkage (MIT-B470-01956).
- x. Pin S-IC transporter actuator jacks to the transporter A-frame support assembly per figure 4-5.
- y. Position the mobile gantry hoists to center directly over lifting eye of S-IC forward handling ring.
- z. Position jack-pad under gantry hoist jack positions.
- aa. Attach gantry hoist to forward handling ring lifting eye using spreader bar (MIT27-B470-10000) and linkage (HT3-B470-10000) per figure 8-3.

NOTE

Place observers in position to direct gantry hoist operations.

- ab. Transfer S-IC stage weight from transporter to A-frame assembly (90M01956-3) and gantry hoist.
- ac. Remove transporter from stage per paragraph 8-3, steps "e" through "s".
- ad. Attach a mobile crane to transporter front dolly A-frame.



Exercise extreme care to prevent damage to stage.

- ae. Remove pins connecting transporter A-frame to transporter and lift A-frame away from S-IC stage.
- af. Repeat steps "ac" and "ad" for other side.

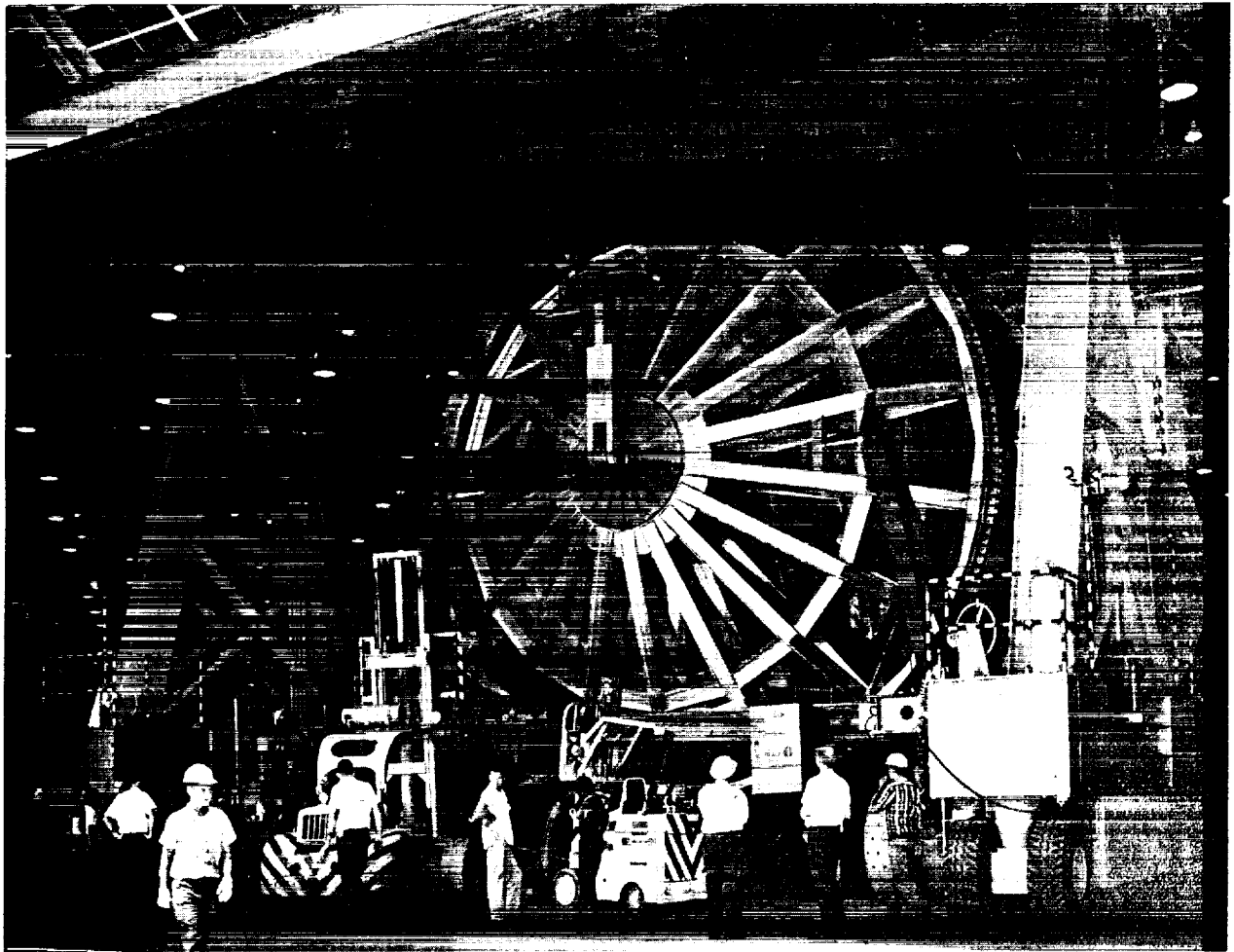


Figure 8-3. S-IC Transfer Mobile Gantry Hoist - Utilization

- ag. Lower transporter front dolly to bottom of strut.
- ah. Lower transporter rear dolly to bottom of strut.
- ai. Using M26-A1 prime mover on rear dolly and two tractors attached to rear of front dolly, tow transporter clear of stage, towing transporter dollies in stage flight direction.
- aj. Position the two side beam assemblies (90M01961-5 and -6) at the aft end of S-IC stage per figure 8-4.
- ak. Position center beam (90M01961-3) between side beams and bolt in place. Torque to 300 (\pm 10) foot-pounds.
- al. Position combined assembly (90M01961-1) so support pads bear on piling cluster hard points on floor.
- am. Connect air lines from air supply to jacks (100 psi minimum).
- an. Place handling ring end support assembly (90M01970-1) under S-IC stage per figure 8-5.
- ao. Place shim plates under each end of the beam. Shims must extend at least 2.00 inches fore and aft of the beam base pads and form a level surface under entire base pad.

- ap. Align support assembly so adapter (90M01970-13) is directly below jack weigh point on S-IC stage handling ring.
- aq. Position support assembly so the support pads fit on the piling cluster hard points on the floor.
- ar. Adjust stand assemblies (90M01970-3) to a height of 79 inches.

NOTE

Position observers to direct gantry hoist and jack operators to adjust vertical loading to allow removal of compression and tension linkages from aft end of S-IC stage.

- as. Remove compression and tension linkages when jacks assume load.
- at. Lower stage in two inch increments until stage comes to rest on forward support stand. Adjust lateral and longitudinal planes between increments.
- au. Adjust jacks for level lateral plane and maintain longitudinal plane \pm one inch.

NOTE

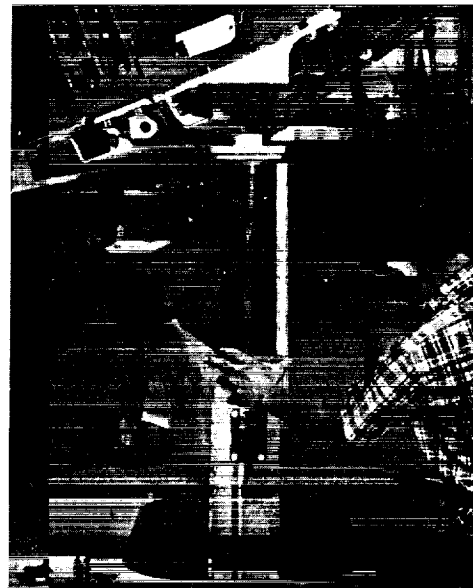
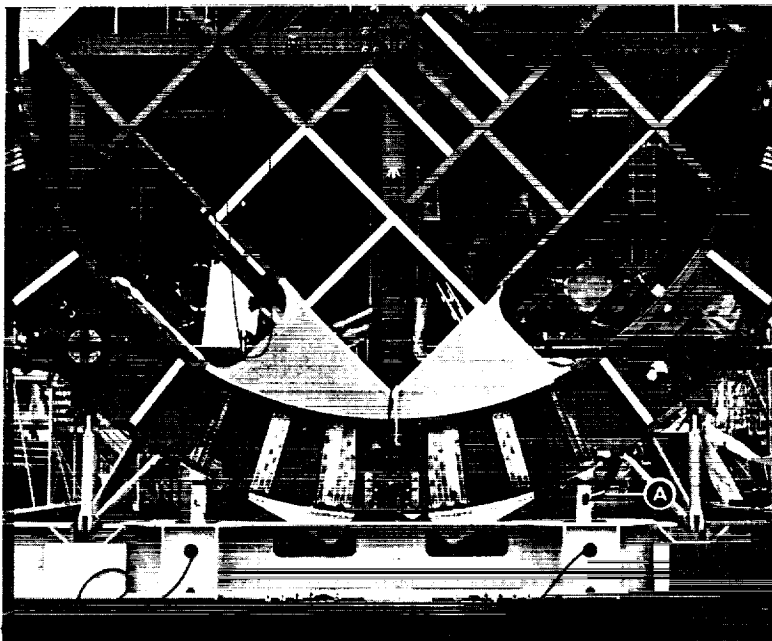
Do not allow jacks to bottom out.

- av. Replace transporter A-frames on transporter.
- aw. Remove forward handling link from stage.

CAUTION

Use extreme care while maneuvering tower equipment near S-IC stage.

- ax. Disassemble and remove transfer towers.



A

Figure 8-4. S-IC Aft Storage Stand - Utilization

8-6. S-IC STAGE TRANSFER FROM STORAGE STANDS TO TRANSPORTER. Transfer the S-IC stage from storage stands (90M01961-1 and 90M01970-1) to transporter per figures 8-2, 8-3, 8-4, and 8-5 as follows:

- a. Assemble and install tower assembly, rubber pad and linkages per paragraph 8-5, steps "a" through "i".
- b. Remove A-frames from transporter front dolly and suspend to transfer tower trolleys using two 2 ton come-a-longs.
- c. Secure transporter A-frames against towers with lines and rigging.
- d. Position A-frame mobile gantry hoist at forward end of stage and connect to lifting eye per steps "y" through "aa" of paragraph 8-5.
- e. Connect air supply to jacks in storage fitting (90M01961-1) at engine end of S-IC stage.
- f. Adjust tension linkage (MIT-B470-01956) on transfer towers to 155 inches.
- g. Raise S-IC stage using jacks and A-frame mobile gantry hoist. Raise in two inch increments maintaining a longitudinal plane \pm one inch and a lateral plane \pm 1/2 inch.

NOTE

Adjust stage after each increment to maintain level plane.

- h. Attach tension linkage assemblies (MIT-B470-01956) and compression linkage assemblies (MIT-B470-01956-1A) to the S-IC stage per paragraph 8-5, steps "s" through "w".

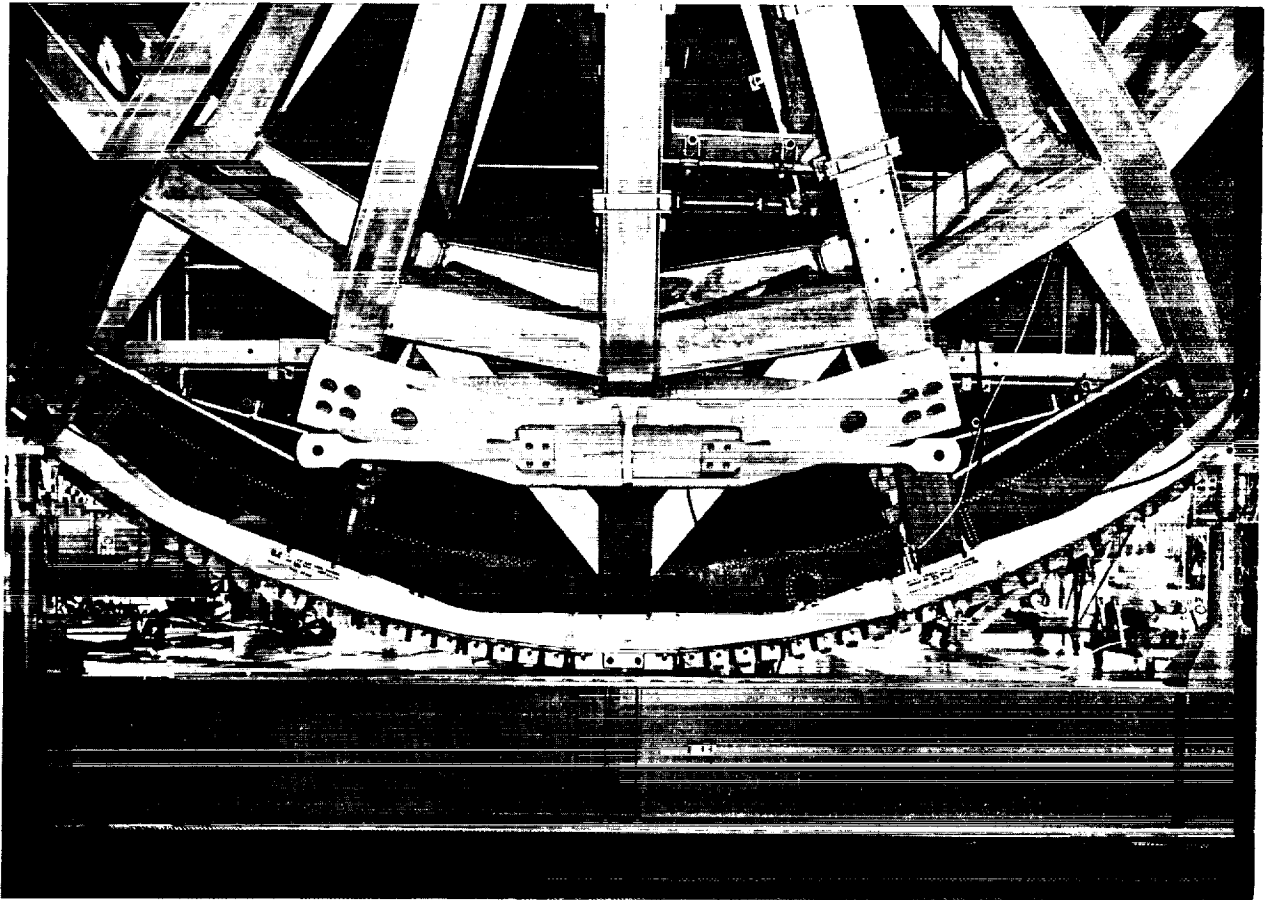


Figure 8-5. S-IC Forward Storage Stand - Utilization

- i. Lower jacks and transfer stage weight to transfer towers.
- j. Disassemble and remove aft storage stand (90M01961-1).
- k. Remove handling ring support assembly (90M01970-1).
- l. Position front and rear transporter dollies under stage moving transporter from forward toward aft end using two tow tractors on front beam of front dolly and prime mover attached to rear of rear dolly.
- m. Position and align front and rear transporter dollies to stage.
- n. Position, align and attach A-frames to transporter front dolly.



Exercise extreme care to prevent damage to stage.

- o. Align and attach transporter to stage per paragraphs 4-5, 4-6 and 4-7.
- p. Using transporter hydraulic system, raise stage to allow removal of A-frame gantry hoist, compression and tension linkage from stage.

NOTE

Place observers in position to direct hydraulic operators in raising operation.

- q. Remove linkage from stage forward handling ring lifting eye.
- r. Remove mobile gantry hoist and jacks.
- s. Remove tension and compression linkage from S-IC stage.
- t. Remove transfer towers.
- u. Checkout transporter per paragraph 5-5.

8-7. S-IC STAGE TRANSFER FROM TRANSPORTER TO TRANSPORTER. Transfer S-IC stage from one transporter to another transporter utilizing support towers (90M01956-3) as follows:

- a. Unload transporter to support towers per paragraph 8-5, steps "a" through "ai".
- b. Load S-IC stage into transporter per paragraph 8-6, steps "a" through "u".

8-8. S-IC STAGE TOWING AT MAF. Towing operations between factory building, stage test building, vertical assembly building or dock area shall be performed as follows:

- a. Assure all items have been accomplished per paragraphs 5-3 through 5-7.
- b. Assure that personnel will observe all items of paragraph 5-8.
- c. Attach tow bar to transporter and M26-A1 prime mover.
- d. Perform checkout per paragraph 5-5.
- e. Place observer in position to monitor height clearance of stage as it enters or leaves buildings.
- f. Check doors for operational status.
- g. Clear roadway.
- h. Coordinate Security escort.
- i. Using hydraulic system raise stage to clear transporter jack stands.

- j. Remove transporter jack stands.
- k. Verify that stage nitrogen pressurization system is operative and data monitors in operation if required.
- l. Move stage carefully.
- m. Complete shut-down procedure per paragraph 3-15.



SECTION IX

S-IC STAGE TRANSPORTING AND HANDLING AT THE MISSISSIPPI TEST FACILITY

9-1. INTRODUCTION.

9-2. This section provides procedures for test stand preparation, S-IC stage removal from barge, erection on test stand, transfer and return of transportation equipment to S-IC storage area, removal of S-IC from test stand and transfer to storage area if required.

9-3. PREPARE TEST STAND TO RECEIVE S-IC STAGE. Prepare the test stand for stage installation as follows:

- a. Perform proof load test on the 200 and 175 ton derrick.
- b. Remove 19th floor dome cover using the 200 ton derrick and sling.



Install guard rails around floor areas where sections are removed.

- c. Remove the 17th, 18th, and 19th floor removable section, using the 200 ton derrick and sling.
- d. Remove any side rails or guard rails from the dock side of the stand that will interfere with the stage installation.
- e. Remove and store auxiliary work platforms that are not required during the stage installation.
- f. Activate the hold down arm upper jaws to the "Full Open" position.
- g. Activate the eight folding leaf sections on the LOX platform to the "Full Up" position.
- h. Activate the four folding leaf sections on the engine access platform to the "Full Up" position and activate the platform sections to the "Full Open" position.
- i. Attach aft rotation brace lifting bar assembly (75M51009-1) and rear link (90M01501-2) to 175 ton derrick hook. Use previously installed 5 inch pin (90M01501-3) and pin puller (65B61113-1) per figure 4-1.
- j. Remove pin puller assembly (65B61113-1) and pin retainer clamp assembly (90M02218-2). Install retainer plate (90M02218-3) in pin retainer clamp assembly (90M02218-2) and install pin retainer assembly (90M02218-1).
- k. Attach forward lifting link (65B61098-1) to 200 ton derrick hook. Use previously installed 5 inch pin (90M01501-3) and pin puller assembly (65B61113-1) per figure 4-4.
- l. Remove pin puller (65B61113-1) and pin retainer clamp assembly (90M02218-2). Install retainer plate (90M02218-3) in pin retainer clamp assembly (90M02218-2) and install pin retainer assembly (90M02218-1).
- m. Attach the spreader assembly (75M51011) and sling assembly (75M51018) to the aft rotation lifting bar assembly (75M51009-1).
- n. Rig sling (75M51018) to rotation brace lower linkage (65B61161-1) by attachment to the single lug (75M51014-1) marked "Horiz. C.G." and install three guide lines for guidance per figure 4-2.

9-4. S-IC STAGE TRANSFER FROM BARGE TO TEST STAND.

CAUTION

This operation is sensitive to wind conditions. Do not undertake task when winds or gusts of more than 15 knots are predicted.

- a. Remove forward and aft stage protective covers in reverse order of installation per paragraphs 4-11 and 4-12.

WARNING

All personnel working from suspended scaffolding or platforms, open structures outside of areas protected by handrails, ladders' buildup scaffolding or extendible platforms more than 20 feet above the ground or elevated deck levels, ladders or scaffolding with overturning radii beyond the protection of deck level handrails, or cherry pickers shall wear safety belts. Soft soled shoes and safety belts are mandatory for all personnel working on the S-IC stage.

- b. Disconnect recorder instrumentation cables from the stage in reverse order of installation per paragraph 4-9.
- c. Hoist rotation brace lower linkage (65B61161-1) to position III on aft end of S-IC stage and attach to the three stage handling fittings per paragraph 4-4 and figure 9-1, phase I. Use previously installed 3 inch pins (75M51020-6 (2) and 75M51020-5) and pin pullers (75M51012-4). Utilize the 175 ton derrick and scaffolding or jacks ladders as required.

NOTE

Communication between the rigger and the derrick operator will be accomplished using portable two-way radio.

- d. Remove the three pin pullers (75M51012-4) and pin retainer clamp assemblies (75M51023-6). Install retainer plates (75M51023-10) in pin retainer clamp assemblies (75M51023-6) and install pin retainer assembly (75M51023-3).
- e. Disconnect spreader assembly (75M51011) and sling assembly (75M51018) from aft rotation lifting bar assembly and rotation brace assembly.
- f. Remove adjustment linkage assembly (65B61114-1) from the aft rotation lifting bar assembly and rotation brace assembly (65B61161-1).
- g. Connect 175 ton derrick with aft rotation lifting bar (90M01501-2) to aft rotation brace assembly (65B61161-1). Use previously installed 4 1/2 inch pin (75M51020-4) and pin puller (75M51012-3).
- h. Remove guide lines from rotation brace assembly.
- i. Install 225 (+ 25) foot guide lines on the eight gimbal actuator outriggers.
- j. Attach two guide lines to the forward lifting linkage assembly (65B61098-1) to guide assembly during installation.

WARNING

Personnel working on the S-IC stage will wear soft soled shoes and safety belts.

- k. Hoist the forward lifting linkage assembly (65B61098-1) and install to the forward handling ring lifting fixture per paragraph 4-4. Use previously installed 5 1/2 inch pin (65B61120-1) and pin puller (65B61113-1). Utilize the 200 ton derrick and scaffolding or jacob ladders, as required.

NOTE

Communications between the rigger and the derick operator will be accomplished using portable two-way radio.

- l. Remove pin puller (65B61113-1) and pin retainer clamp assembly (75M51023-5). Install retainer plate (75M51023-9) in pin retainer clamp assembly (75M51023-5) and install pin retainer assembly (75M51023-2).
- m. After installation, remove the guide lines attached by step "j".
- n. Raise the stage approximately one-inch and then disconnect the stage from the transporter per Section VII.

NOTE

Raise or lower the transporter wheel units to align the connecting pins.

CAUTION

The S-IC tanks will be pressurized before disconnecting the pressure system to compensate for any leakage during installation on the test stand.

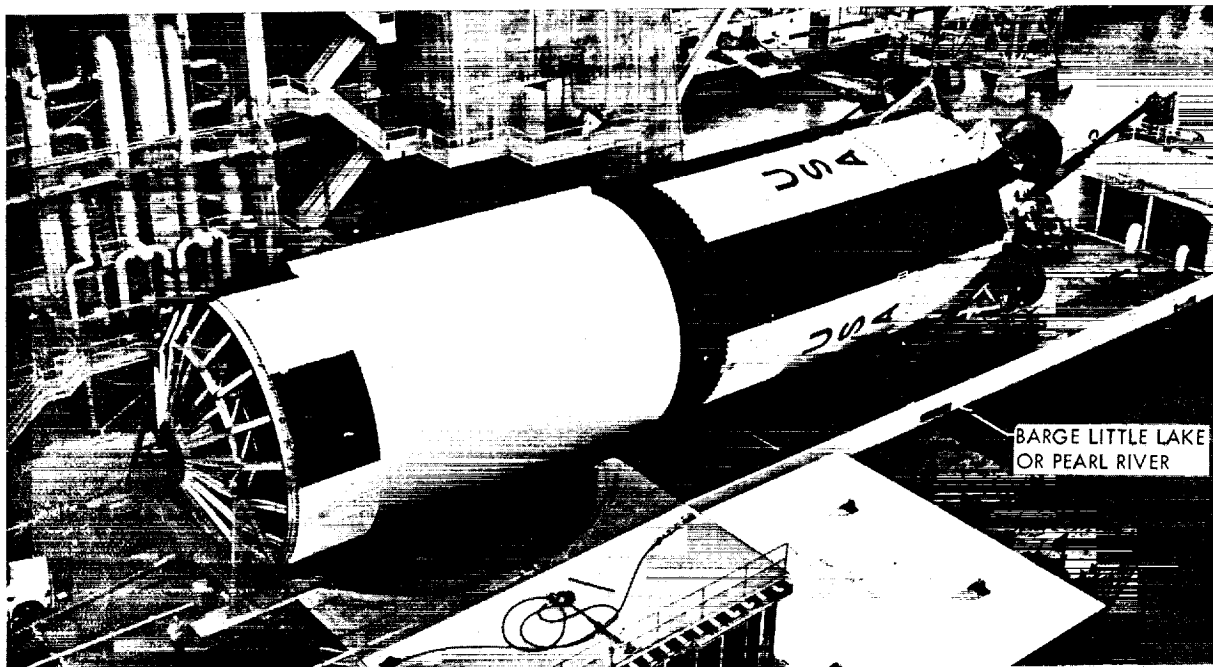
- o. Disconnect the pressure monitor and control unit (65B64146-1) from the stage per Section VII.
- p. Remove the transporter front dolly connecting linkage (90M01715) per figure 4-5 and secure the transporter per paragraph 3-15.
- q. Lift S-IC stage in horizontal position per figure 9-1, phase II, using the 200 ton and 175 ton derricks.
- r. Lift and rotate the stage to the vertical position per figure 9-1, phase III.
- s. Rig a mobile crane to the double fitting lug (75M51014-2) marked "Vent C.G.", on rotation brace lower linkage assembly (65B61161-1). Place a slight tension on cable assembly.
- t. Install adjustment linkage assembly (65B61114-1) on rotation brace lower linkage assembly (65B61161-1).
- u. Attach three (3) each guide lines to the aft end of the rotation brace lower linkage assembly to control the movement during removal.
- v. Remove the three (3) pins (75M51020-6 (2) and 75M51020-5) connecting the rotation brace lower linkage assembly to the stage handling fittings, after first installing the pin pullers (75M61012-4), in the following sequence:
 - (1) Remove the two (2) aft pins first.
 - (2) Adjust tension in sling assembly to assure lower linkages are free from any binds.
 - (3) Retract upper pin and remove rotation brace lower linkage assembly from stage.
- w. Replace and secure the rotation lower linkage assembly in its fixture assembly (75M51025) and detach mobile crane.

- x. Rotate the S-IC stage to the proper stage-to-test-stand orientation.
- y. Lift and install the stage into the test stand, using the 200 ton derrick and guide lines per figure 9-1, phase V.

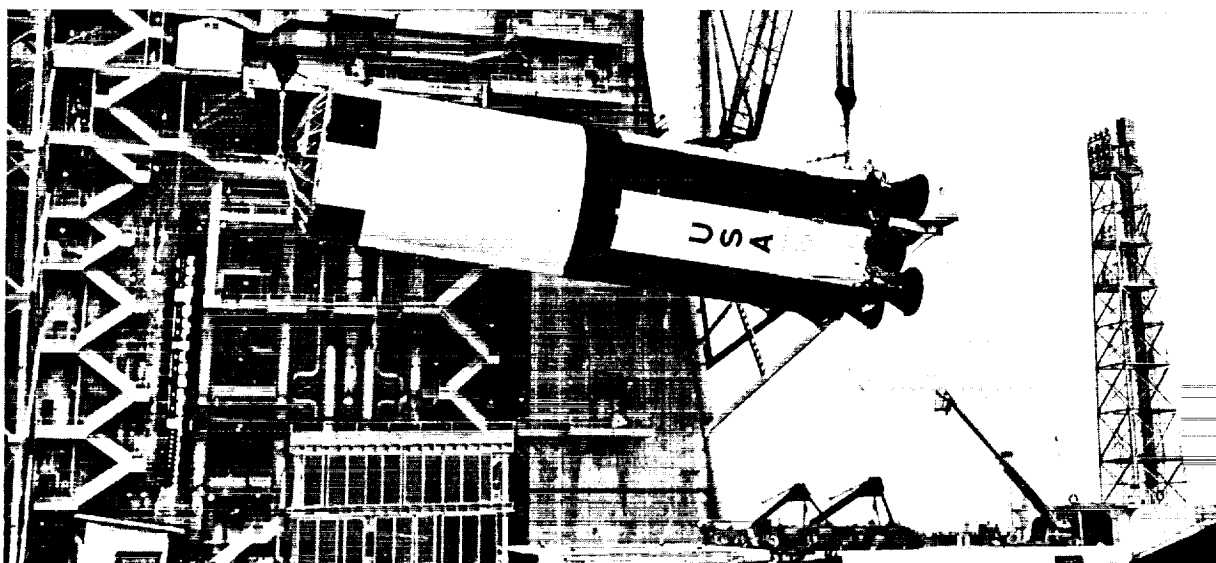
NOTE

Communication between the rigger and the derrick operator will be accomplished using portable two-way radio.

- z. Set the stage on the hold hown arm pads.

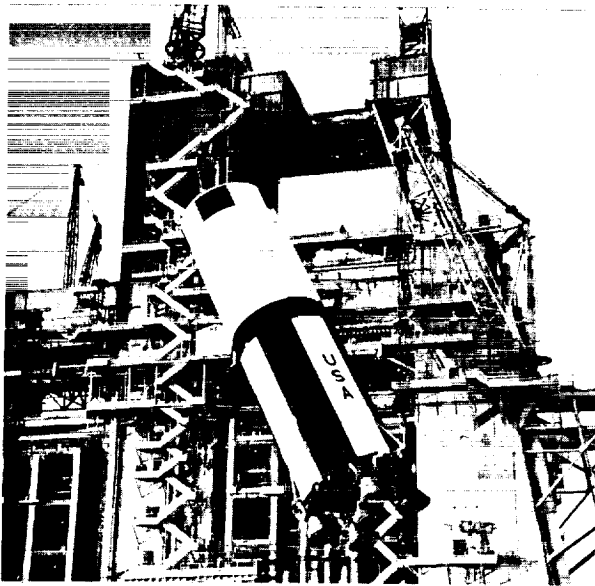


PHASE I

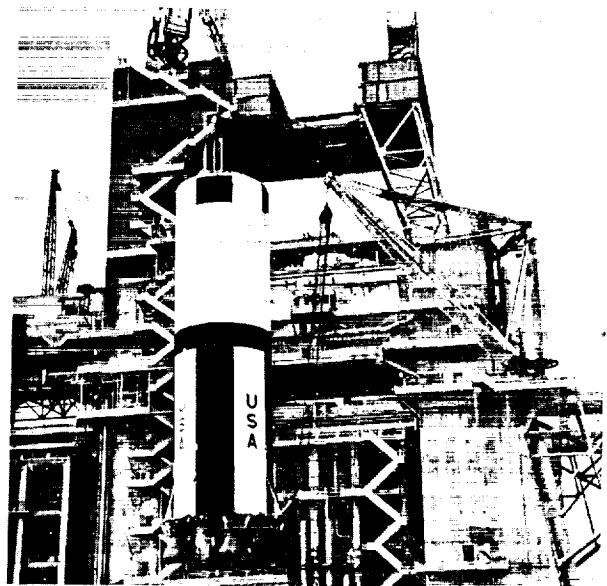


PHASE II

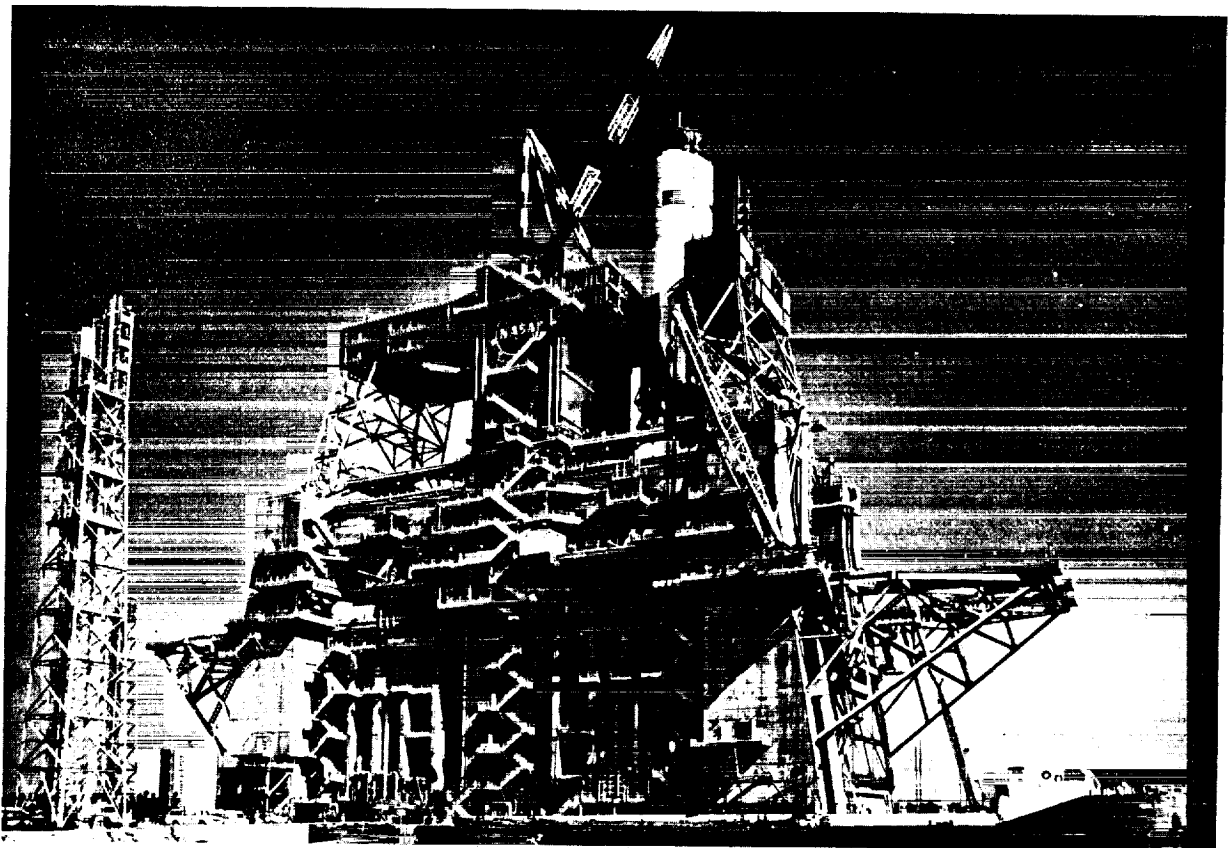
Figure 9-1. S-IC Stage Transfer From Barge To Test Stand (Sheet 1 of 2)



PHASE III



PHASE IV



PHASE V

Figure 9-1. S-IC Stage Transfer From Barge To Test Stand (Sheet 2 of 2)

- aa. Connect the LOX tank pressurization and monitoring lines to the lox tank per figure 4-8, detail B and to GN₂ service panel number 7 located on the 18th floor.
- ab. Connect the fuel tank pressurization and monitoring lines the fuel tank per figure 4-8, detail B and to GN₂ service panel number 8 located on the 12th floor.
- ac. Install shim sets in the four hold down positions on the stage.
- ad. Activate the four upper jaw hold down assemblies and lock the stage in the test stand.
- ae. Check the stage alignment.
- af. Remove the forward lifting linkage assembly in reverse order of "k" and "l" above per figure 9-2.
Remove guide lines from the stage.
- ag. Replace removable sections, dome, guard rails, and auxilliary platforms removed in paragraph 9-3.
- ah. Activate the eight folding leaf sections on the LOX platform to the "Full Down" position.
- ai. Activate the engine platform sections to the "Full Closed" position and activate the four folding leaf sections to the "Full Down" position.

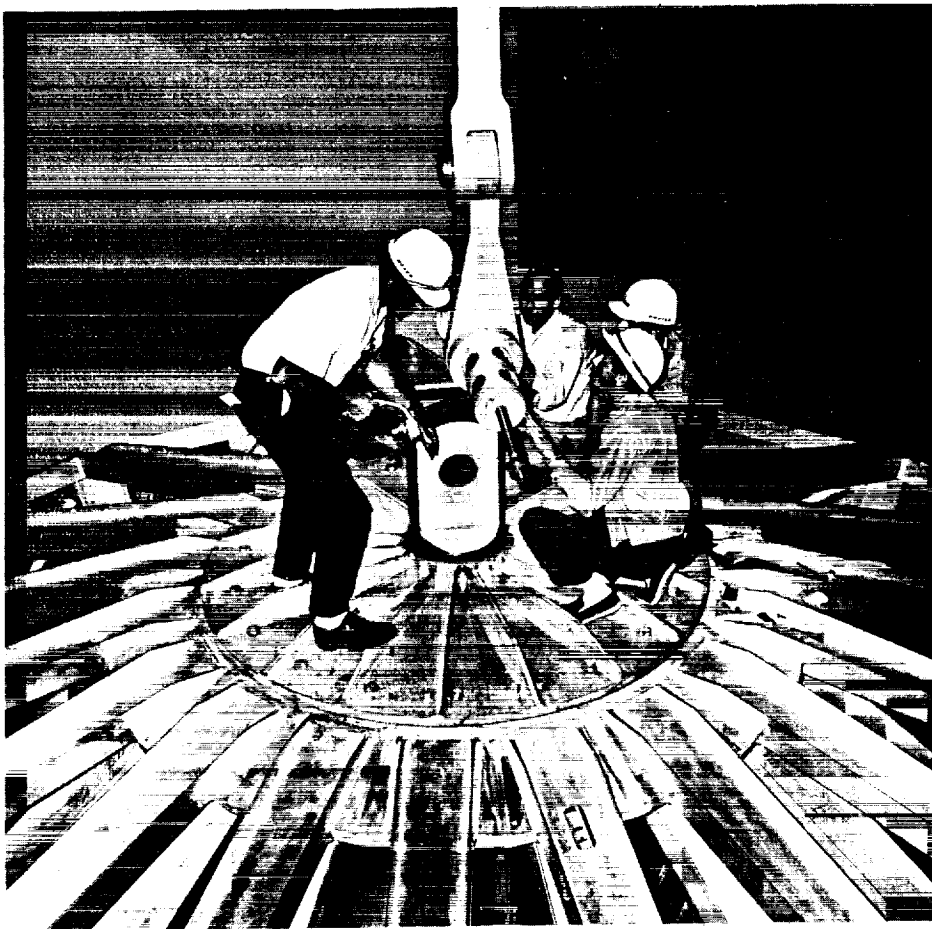


Figure 9-2. Forward Lifting Linkage - Removal

9-5. MOVING TRANSPORTER FROM BARGE TO BOOSTER STORAGE BUILDING. Remove the transporter and the instrumentation equipment as follows:

- a. Disconnect the electrical, pneumatic, communications lines and messenger cable between the front and rear dollies of transporter.
- b. Remove the tie-down provisions of the front and rear transporter dollies in reverse per paragraph 6-3.
- c. Checkout prime mover per paragraph 3-8.
- d. Remove the stage protective covers from the barge and transport to the Booster Storage Building.
- e. Transport instrumentation packages and cables to the Booster Storage Building.
- f. Remove all other loose equipment and kits and transport to the Booster Storage Building.
- g. Position prime mover on barge and connect to the rear dolly with tow bar.
- h. Tow the rear transporter dolly to Booster Building and secure.
- i. Position prime mover on barge and connect to the front dolly with tow bar.
- j. Tow front dolly to Booster Storage Building and secure.

9-6. MOVING TRANSPORTER FROM BOOSTER STORAGE BUILDING TO BARGE. Transfer transporter and associated equipment as follows:

- a. Checkout prime mover, transporter, tank pressure control and monitor unit and data recording equipment per Section III.
- b. Tow the front transporter dolly using prime mover from the Booster Storage Building and position on the barge in the approximate stage loading position.
- c. Tow the rear transporter dolly using prime mover from the Booster Storage Building and position on the barge in the approximate stage loading position.
- d. Align and position front and rear transportation dollies on the barge to receive stage.
- e. Shore or tie-down the transporter to the barge, using shoring kit stored in Booster Storage Building per paragraph 6-3.
- f. Connect messenger cable and associated electrical, communication and pneumatic lines between forward and aft dollies of transporters.
- g. Transport the instrumentation package from the Booster Storage Building to the barge and install on the transporter.
- h. Transport the stage protective covers from the Booster Storage Building to the barge.

9-7. PREPARE TEST STAND TO REMOVE S-IC STAGE. Prepare the test stand for stage removal same as loading per paragraph 9-3,

9-8. TRANSFER S-IC STAGE FROM TEST STAND TO BARGE. Remove S-IC stage from test stand and load into barge as follows:

- a. Position transporter and associated equipment in barge per paragraph 9-6.

WARNING

All personnel working from suspended scaffolding or platforms, open structures outside of areas protected by handrails, ladders, buildup scaffolding or extendible platforms more than 20 feet above the ground or elevated deck levels, ladders or scaffolding with over-turning radii beyond the protection of deck level handrails, or cherry pickers shall wear safety belts. Soft soled shoes and safety belts are mandatory for all personnel working on the S-IC stage.

CAUTION

This operation is sensitive to wind conditions. Do not undertake when wind or gusts of more than 15 knots are predicted.

- b. Disconnect the S-IC stage from the test stand.
- c. Prepare test stand for removal of stage per paragraph 9-7.
- d. Attach the forward lifting linkage assembly (65B61098-1) to the forward handling ring attach point using the 200 ton derrick per figure 9-2. Lubricate inside surface of eye with Texaco Marfax all purpose grease.

NOTE

Communication between the derrick operator and riggers will be accomplished using portable two-way radios.

- e. Attach eight guide lines to gimbal actuator outriggers or stage attach fittings.
- f. Release hold down arm upper jaws and remove shim plates.

CAUTION

The S-IC tanks will be pressurized before disconnecting the pressure system to compensate for any leakage during installation into transporter.

- g. Pressurize tanks to offset leak rate and temperature change per paragraph 4-2.
- h. Disconnect the tank pressurization control and monitoring lines from the stage per section VII.
- i. Lift and remove the stage from the test stand with 200 ton derrick per figure 9-1.

NOTE

Communications between the derrick operator, riggers and observers will be accomplished using portable two-way radios. Observers will be located at critical clearance locations.

- j. Lower the stage and attach the rotation brace lower linkage (65B61161-1) to the stage attach fittings, using the 175 ton derrick and mobile crane or hydra-boom at position similar to figure 9-1, phase IV per paragraph 4-4.
- k. Rotate the stage to the horizontal position using the 200 ton derrick, and the 175 ton derrick similar to figure 9-1, phase III and II.

NOTE

Communications between derrick operators and riggers will be accomplished using portable two-way radios.

- l. Attach guide lines to forward handling ring and with the 200 ton and 175 ton derrick position and lower the stage onto the transporter/barge.
- m. Load S-IC stage to the transporter per paragraphs 4-5 through 4-8.

NOTE

Raise or lower the transporter wheel units to align the connecting pins.

- n. Remove the aft rotation brace assembly (65B61097-1) in reverse order per paragraph 4-4.
 - o. Remove the forward lifting linkage assembly (65B61098-1) in reverse order per paragraph 4-4.
 - p. Install the tank pressurization control and monitoring equipment (65B64146-1) to stage and the transporter per paragraph 4-8.
 - q. Attach the instrumentation to the stage per paragraphs 4-9 and 4-10.
 - r. Install forward and aft stage protective covers (90M01723-1 and 90M01781-1) per paragraphs 4-11 and 4-12.
 - s. Transfer other stage and engine components onto the barge and secure.
- 9-9. TRANSPORT OF S-IC STAGE FROM BARGE TO BOOSTER STORAGE BUILDING. Remove the S-IC stage from the barge and transfer into the Booster Storage Building per figure 9-3 as follows:
- a. Unload barge per paragraph 6-10.
 - b. Tow the stage/transporter from the barge to the Booster Storage Building.
 - c. Secure the transporter in the Booster Storage Building per paragraph 3-15.
 - d. Connect the tank pressure monitor and control system (65B64146) to the facility power and GN₂ supply.
 - e. Disconnect the tow bar and prime mover from the transporter, and return the prime mover to a secure area.
 - f. Remove loose equipment and kits from the barge and transport them to the Booster Storage Building for storage.

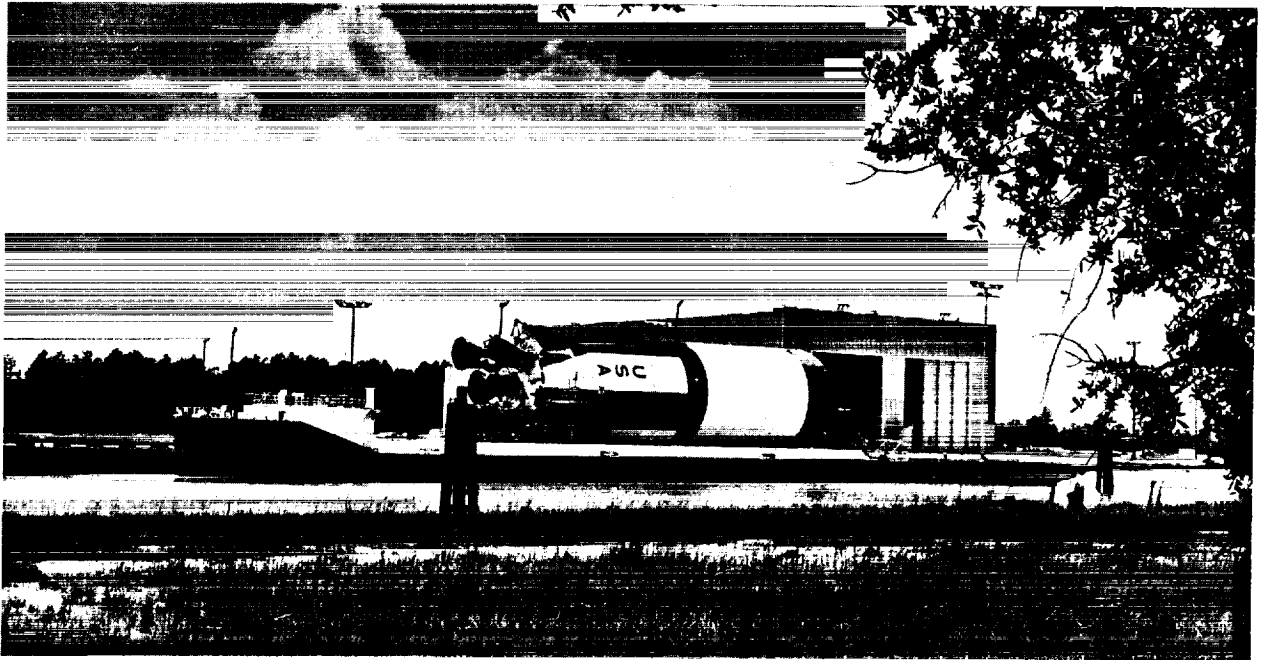


Figure 9-3. Transport of S-IC Stage From Barge To Booster Storage Building

9-10. TRANSPORT OF S-IC STAGE FROM BOOSTER STORAGE BUILDING TO BARGE, Transfer S-IC stage as follows:

- a. Checkout prime mover and transporter per paragraphs 5-3, 5-4, and 5-5.
- b. Checkout tank Pressure Control and Monitor Unit per paragraph 5-6.
- c. Activate travel data monitoring equipment per paragraph 5-8.
- d. Activate tank Pressure Control and Monitor Unit per paragraph 5-7.
- e. Tow per paragraph 5-9.
- f. Load barge per paragraph 6-6.
- g. Remove prime mover and tow bar to storage.

SECTION X

S-IC STAGE TRANSPORTING AND HANDLING AT THE KENNEDY SPACE CENTER

10-1. INTRODUCTION.

10-2. This section provides procedures for transporting S-IC stage from dock, preparation for and erection of S-IC stage on the mobile launcher.

10-3. UNLOADING S-IC STAGE FROM BARGE AT KSC. Unload barge per paragraph 6-9.

10-4. TRANSPORT S-IC STAGE FROM DOCK TO VAB. Transport the S-IC stage as follows:

- a. Form the convoy with a lead security escort vehicle, prime mover/transporter, fire truck, support truck, and trailing security escort vehicle.



Maximum allowable towing speed during transportation between the dock site and the VAB is 5 mph.

- b. Move the convoy per paragraph 5-9 on the towing route from the dock area to the VAB transfer aisle.
- c. Position the transporter and S-IC stage in the VAB transfer aisle position per figure 10-1.

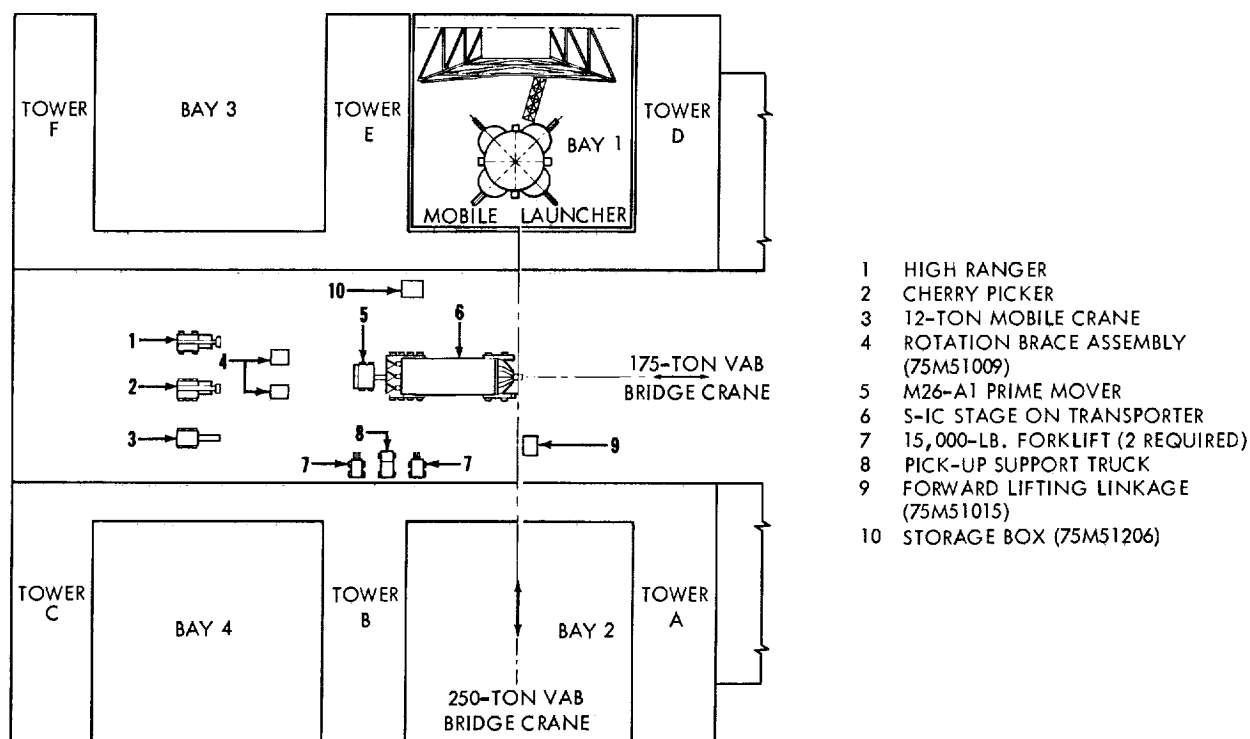


Figure 10-1. VAB Equipment Position For S-IC Stage Erection

- d. Direct the fire truck, two (2) security vehicles and the 3/4 ton support pick-up truck to standby in the parking area at the south side of the VAB low bay.
- e. Connect tank pressure monitor and control equipment (65B64146-1) to facility gas and electrical equipment.
- f. Remove S-IC stage shipment covers in reverse order of installation per paragraphs 4-11 and 4-12.
- g. Remove data recorder equipment and cables in reverse order of installation per paragraph 4-9.
- h. Perform receiving inspection.
- i. Remove electrical grounding bracket at station 116, position I of S-IC stage per manual MSFC-MAN-035.

NOTE

See technical manual index MSFC-MAN-000 for specific manual vehicle dash number.

10-5. PREPARATION FOR STAGE ERECTION. Prepare for stage erection as follows:

- a. Proof load test handling equipment per paragraph 10-6.
- b. Position handling equipment per paragraph 10-7.
- c. Prepare facilities per paragraph 10-8.
- d. Prepare S-IC stage per paragraph 10-9.
- e. Remove S-IC stage from transporter per paragraph 10-10.

10-6. HANDLING EQUIPMENT PROOF LOADING. Verify that the following equipment has been currently proof loaded and is available for usage:

- a. Rotation brace (75M51009).
- b. Forward lifting linkage (75M51015).
- c. Sling (75M51018) and spreader (75M51011).
- d. Cable (75M51611).
- e. Five slings (75M51050-1 thru -5).

10-7. HANDLING EQUIPMENT POSITIONING. Load the following equipment on the flat bed trailer and position on floor near S-IC stage per figure 10-1:

- a. Rotation brace-upper linkage (75M51009-5) in fixture (75M51148) using slings (75M51150-1 and -2).
- b. Rotation brace-lower linkage (75M51009-6) in fixture (75M51025) using slings (75M51150-4 and -5).
- c. Forward lifting linkage (75M51015) in fixture (75M51149) using slings (75M51150-1 and -3).
- d. Storage box (75M51206).
- e. Spreader assembly (75M51011) and sling (75M51018).
- f. Cable assembly (75M51611).
- g. Four guide lines each 50 feet long.

10-8. FACILITY PREPARATION. Proceed with preparation for stage erection as follows:

- a. Verify that VAB transfer aisle and the appropriate high bay are clear of any obstructions that would interfere with the planned operation. Verify that necessary lighting is available.
- b. Arrange for transfer aisle and high bay doors to be closed during retraction of extensible platforms prior to stage erection and during stage erection.

- c. Install pins and pin pullers per figure 10-2 in their respective ports on the erection equipment.
- d. Verify that hold-down service platform kits are installed at positions I and III hold-down arms and zero level well is roped off on the mobile launcher.
- e. Install guide bracket kit (75M51526) at positions I and III on mobile launcher per figure 10-3.
- f. Attach rotation brace upper linkage (75M51009-5) to the 175 ton bridge crane hook using previously installed 9 1/2 inch pin (75M51020-1) and pin puller (75M51012-1) shown in figure 4-1.
- g. Remove pin puller (75M51012-1) and pin retainer clamp assembly (75M51023-4). Install retainer plate (75M51023-8) in pin retainer clamp assembly (75M51023-4) and install pin retainer assembly (75M51023-1).
- h. Hoist upper linkage clear of fixture (75M51148) and attach sling (75M51018) and spreader (75M51011) to upper linkage per figure 4-2.
- i. Rig sling (75M51018) to lower linkage (75M51009-6) of rotation brace assembly.
- j. Attach sling to single lug (75M51014-1) marked "Horiz. C.G.".

PIN	PIN PULLER	QUANTITY	LOCATION
75M51020-1	75M51012-1	1	Aft lifting linkage, figure 4-1
75M51020-1	75M51012-1	1	Forward lifting linkage, figure 4-4
75M51015-5	75M51012-2	1	Forward lifting linkage, figure 4-4
75M51020-4	75M51012-3	1	Rotation brace, figure 4-3
75M51020-5	75M51012-4	1	Rotation brace, figure 4-3
75M51020-6	75M51012-4	2	Rotation brace, figure 4-3

Figure 10-2. Pin and Pin Puller Locations

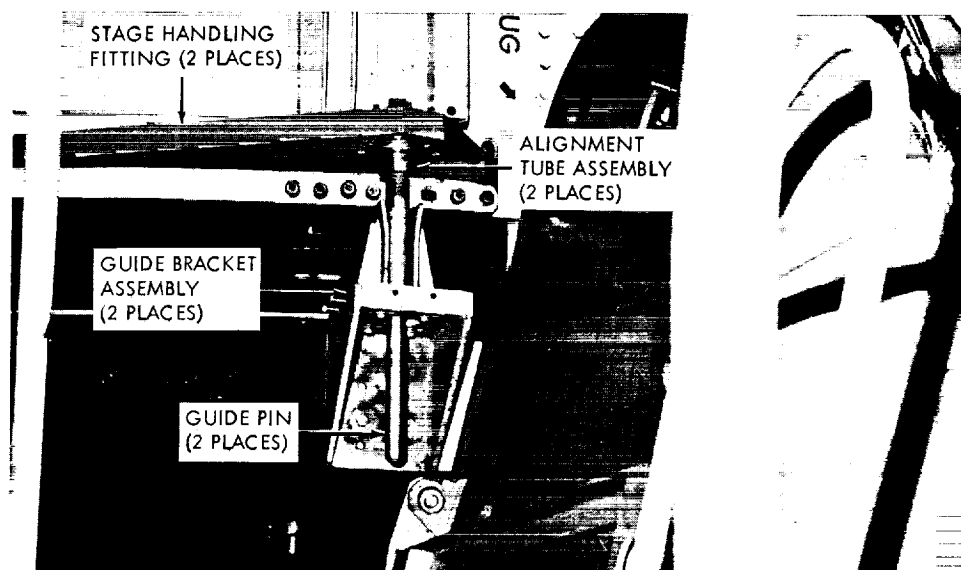


Figure 10-3. S-IC Stage/Mobile Launcher Alignment Equipment

10-9. S-IC STAGE PREPARATION. Proceed with preparations to hoist as follows:

WARNING

All personnel working from suspended scaffolding or platforms, open structures outside of areas protected by handrails, ladders, buildup scaffolding or extendible platforms more than 20 feet above the ground or elevated deck levels, ladders or scaffolding with overturning radii beyond the protection of deck level handrails, or cherry pickers shall wear safety belts. Soft soled shoes and safety belts are mandatory for all personnel working on the S-IC stage.

- a. Checkout prime mover and transporter per Section III.
- b. Move S-IC stage to proper position to place on mobile launcher in Bay 1 per figure 10-1. A mirror arrangement will be utilized for Bay 3.
- c. Disconnect facility gas supply and reposition nitrogen supply to forward end of stage and reconnect to tank pressure and control equipment to facility gas supply.
- d. Hoist rotation brace lower linkage to position III on aft end of the S-IC stage per figure 4-3 and attach to the three stage handling fittings using previously installed 3 inch pins (75M51020-6 (2) and 75M51020-5) and pin pullers (75M51012-4). The high ranger and cherry picker will provide access.
- e. Remove the three pin pullers (75M51012-4) and pin retainer clamp assemblies (75M51023-6). Install retainer plates (75M51023-10) in pin retainer clamp assemblies (75M51023-6) and install pin retainer assemblies (75M51023-3).
- f. Detach sling (75M51018) from rotation brace lower linkage (75M51009-6).
- g. Remove adjustment linkage (75M51013) and stow pallet or flat bed trailer.
- h. Remove spreader (75M51011) and sling (75M51018) from rotation brace upper linkage per figure 4-2. Stow sling and spreader on pallet in transfer aisle.
- i. Connect rotation brace upper linkage to lower linkage using previously installed 4 1/2 inch pin (75M51020-4) and pin puller (75M51012-3).
- j. Remove pin puller (75M51012-3) and pin retainer clamp assembly (75M51023-5). Install retainer plate (75M51023-9) in pin retainer clamp assembly (75M51023-5) and install pin retainer assembly (75M51023-2).
- k. Attach forward lifting linkage assembly (75M51015) to the 250 ton crane hook using previously installed 9 1/2 inch pin (75M51020-1) and pin puller (75M51012-1) per figure 4-4.
- l. Remove pin puller (75M51012-1) and pin retainer clamp assembly (75M51023-4). Install retainer plate (75M51023-8) in pin retainer clamp assembly (75M51023-4) and install pin retainer assembly (75M51023-1).
- m. Hoist forward lifting linkage (75M51015) clear of its fixture (75M51149) and attach to stage forward handling tool using the previously installed 5 1/2 inch pin (75M51015-5) and pin puller (75M51012-2) per figure 4-4. Use forklift with man platform for access.
- n. Remove pin puller (75M51012-2) and pin retainer clamp assembly (75M51023-5). Install retainer plate (75M51023-9) in pin retainer clamp assembly (75M51023-5) and install pin retainer assembly (75M51023-2).

10-10. S-IC STAGE REMOVAL FROM TRANSPORTER. Remove S-IC stage from transporter per procedures in Section VII

CAUTION

S-IC tank pressurization and control system must be removed and all ports capped per paragraph 7-4.

10-11. S-IC STAGE ERECTION. Transfer S-IC stage from transporter to mobile launcher as follows:

WARNING

No personnel will be allowed under the stage during the entire erection operation.

- a. Request crane operators to hoist the S-IC stage approximately one (1) foot to insure clearance at all points between the S-IC stage and S-IC transporter.

WARNING

All personnel working from suspended scaffolding or platforms, open structures outside of areas protected by handrails, ladders, buildup scaffolding or extendible platforms more than 20 feet above the ground or elevated deck levels, ladders or scaffolding with overturning radii beyond the protection of deck level handrails, or cherry pickers shall wear safety belts. Soft soled shoes and safety belts are mandatory for all personnel working on the S-IC stage.

- b. Remove two (2) self-aligning bearings on rear dolly trunnion supports utilizing forklift with man platform. Tow transporter rear dolly approximately 50 foot clear of stage forward skirt to allow 90° rotation of stage.
- c. Hoist the S-IC stage clear of the transporter dollies per figure 10-4.
- d. Rotate through 90° and lower to a position convenient for access to the rotation brace assembly by use of forklifts with man platforms per figure 10-5.
- e. Remove the 4 1/2 inch pin (75M51020-4) connecting the upper linkage assembly (75M51009-5) to the lower linkage assembly (75M51009-6) after installing the 4 1/2 inch pin puller assembly (75M51012-3).

CAUTION

Attach tag line to rotation brace assembly (75M51009-3) to control possible movement.

- f. Replace the upper linkage assembly in fixture assembly (75M51148) and detach from 175 ton crane hook after installing 9 1/2 inch pin puller assembly (75M51012-1) and removing pin (75M51020-1).
- g. Rig the 12 ton mobile crane to the double lifting lug (75M51014-2) marked "Vert C.G.", on rotation brace lower linkage assembly (75M51009-6). Place a slight tension on cable assembly.
- h. Install adjustment linkage assembly (75M51013) on rotation brace lower linkage assembly (75M51009-6).
- i. Attach three (3) each guide lines to the aft end of the rotation brace lower linkage assembly to control the movement of the linkage assembly during removal.
- j. Remove the three (3) pins (75M51020-6 (2) and 75M51020-5) connecting the rotation brace lower linkage assembly to the stage handling fittings after installing the pin pullers (75M51012-4), in the following sequence:
 - (1) Remove the two aft pins first.
 - (2) Adjust tension in sling assembly to assure lower linkages are free of any binds.
 - (3) Retract upper pin and remove rotation brace from stage.
- k. Replace and secure the rotation brace assembly lower linkage in its fixture assembly (75M51025) and detach the 12 ton mobile crane.

- l. Attach four 50 foot guide lines to the stage, one at each engine position. Coil approximately 30 foot of line on the actuator brackets, leaving approximately 20 foot hanging loose. Secure with tape as necessary.

m. Rotate stage 180° .

- n. Hoist S-IC stage approximately 210 feet, clearing diaphragm wall by approximately 20 feet per figure 10-6.

o. Transfer S-IC stage from transfer aisle to the high bay.

- p. Lower S-IC stage over mobile launcher hold down arms and rotate stage for coarse alignment of S-IC stage and hold down arms.

NOTE

Stop lowering operation when stage handling fittings are approximately four (4) feet above the hold down arm elevation.

- q. Install alignment tube assembly (75M51526-4) on stage handling fittings (65B61108-5 for S-IC-11, 14, 15 and 65B61028-5 for S-IC-12 and 13) at stage position I-D and (65B61108-1 for S-IC-11, 14, 15 and 65B61028-1 for S-IC-12 and 13) stage position III-B per figure 10-3.

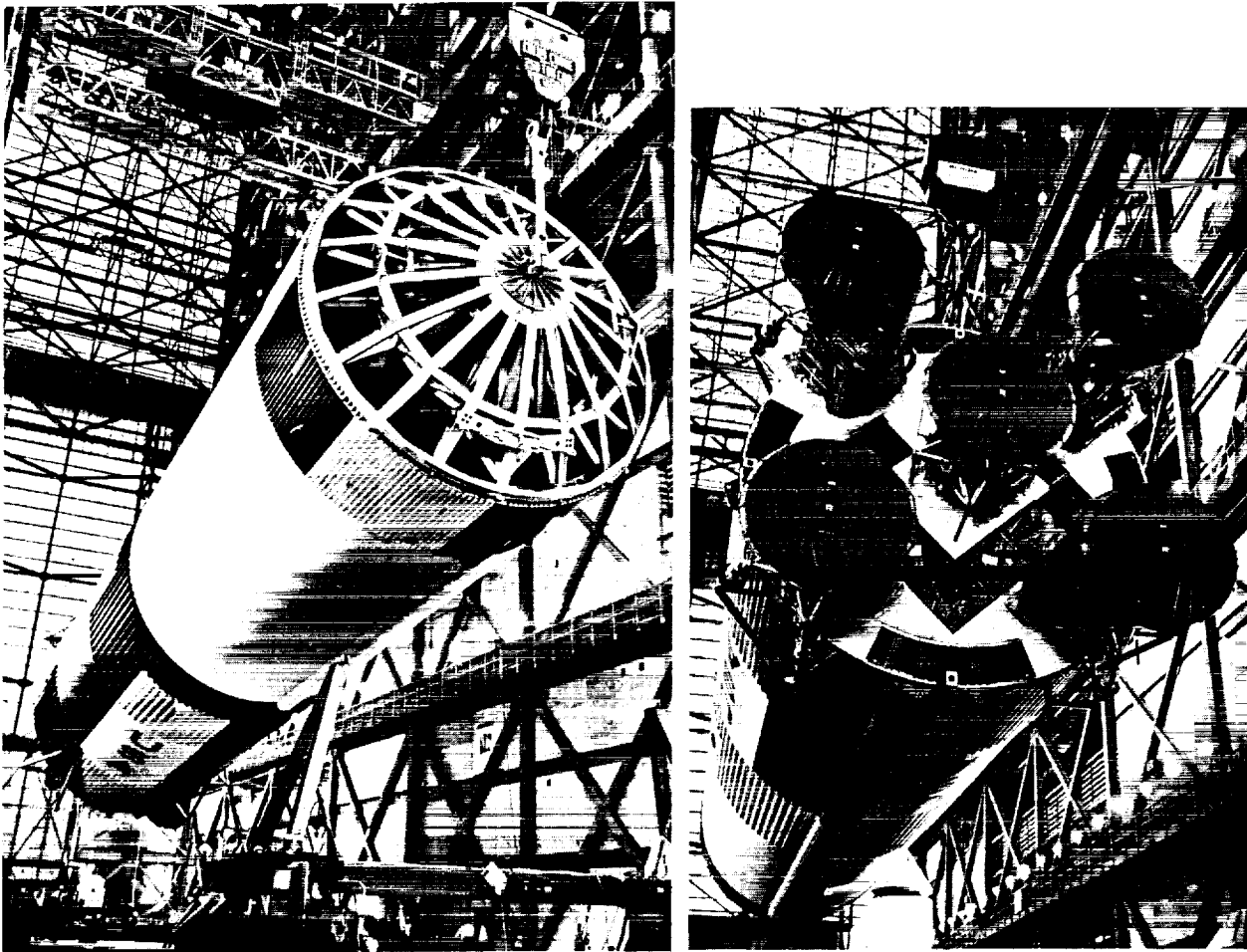


Figure 10-4. S-IC Stage Erection At KSC - Phase I

- r. Install one (1) each pin assembly (75M51526-5) in each of two (2) alignment tube assemblies installed in previous step.
 - s. Lower stage for fine alignment by engaging one (1) each pin assembly (75M51526-5) in guide assembly (75M51526-8) and guide assembly (75M51526-9) at stage position I-D and stage position III-B respectively.
 - t. Actuate hold down arms on mobile launcher.
 - u. Connect forward umbilical service unit to S-IC stage.
- 10-12. S-IC STAGE PRESSURIZATION. Install pressurization control and monitor unit on the mobile launcher deck as a standby pressurization system.
- a. Hoist the pressure control and monitor unit (65B64146-1) to the mobile launcher deck, position II hold down assembly area.
 - b. Route LOX and fuel tank pressurization and sense lines from the pressure control and monitor unit (65B64146-1) to the tank fittings.

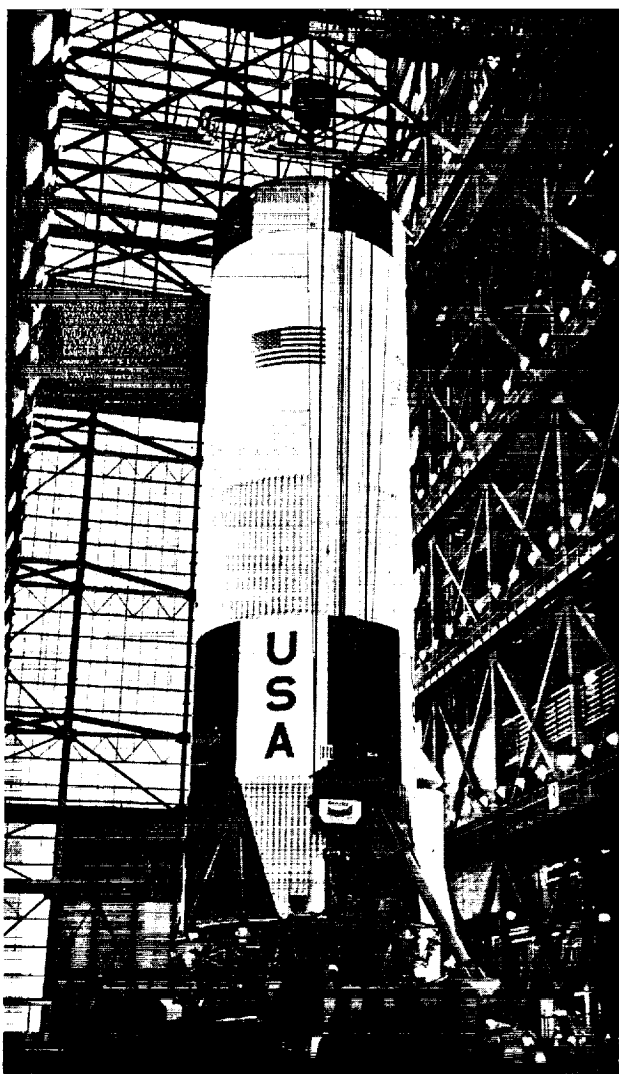


Figure 10-5. S-IC Stage Erection At KSC - Phase II

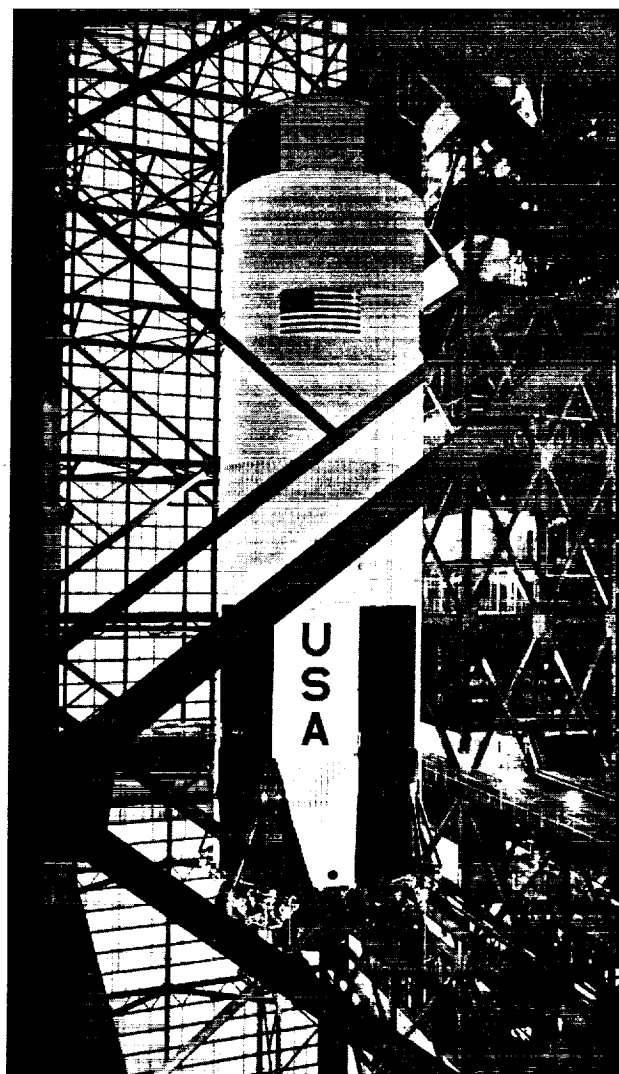


Figure 10-6. S-IC Stage Erection At KSC - Phase III

- c. Tighten pressurization line joints per figure 4-8.
- d. Tighten sense line joints per figure 4-8.
- e. Connect pressurization lines to tank fittings per figure 4-8.
- f. Connect sense lines to tank fittings per figure 4-8.
- g. Connect pressurization lines to pressure control and monitor unit per figure 4-8.
- h. Connect sense lines to pressure control and monitor unit per figure 4-8.
- i. Verify tank pressurization 4 (\pm 1) psig.
- j. Verify pressure control and monitor unit cylinders are changed to 3500 psig maximum.

10-13. S-IC STAGE POST ERECTION EQUIPMENT SECURING. Immediately after the S-IC stage is installed per paragraph 10-11 perform the following:

- a. Remove alignment equipment per figure 10-3 from stage handling fittings and hold-downs. Stow equipment.
- b. Disconnect forward lifting linkage (75M51015) from forward handling tool by removing 9 1/2 inch pin (75M51020-1) with puller (75M51012-1).
- c. Place forward lifting linkage in fixture (75M51149). Disconnect from 250 ton crane by removing the 9 1/2 inch pin (75M51020-1) and pin puller (75M51012-1). Stow in storage box (75M51206) on flat bed trailer.
- d. Remove power cables, air hoses and messenger cable from transporter. Coil and place on pallet or place on cable reels.
- e. Move prime mover and transporter to storage area and secure per paragraph 3-15.

10-14. S-IC STAGE HANDLING FITTINGS - REMOVAL. Remove stage handling fittings attached to S-IC stage and replace fasteners per procedures in manual MSFC-MAN-035.

NOTE

See technical manual index MSFC-MAN-000 for specific manual vehicle dash number.

APPENDIX

DEFINITION OF TERMS AND ABBREVIATIONS

Definition of terms and abbreviations used in this manual are as follows:

TERMS.

Ackermann Steering - Turning the inner wheels on transporter at a greater angle than outer wheels to give true rolling of wheels in cornering.

Banding Machine - A portable machine to apply steel straps tightly around objects to be secured.

Cherry Picker - A mobile crane with oblique boom of lattice construction used to lift equipment.

Come-A-Long Hoist - A portable ratchet operated chain lifting device.

Forklift - A mobile machine for lifting heavy objects by means of steel fingers inserted under the load.

High Ranger - A mobile crane with hydraulic operated folding boom to lift personnel to high places.

Horiz cg - A lifting point for horizontal center of gravity.

Jack Screw - A screw operated jack used to exert pressure to align S-IC stage in transporter.

Lift-A-Loft - A mobile hydraulic operated elevating personnel platform.

Messenger Wire - A steel cable used to support other cables and hoses between sections of the transporter.

Parallel Steering - Turning all wheels on transporter to the same angle and parallel to each other to permit diagonal transporter movement.

Phase Rotation Light - Light at front and rear consoles of the transporter which indicates that power generated at the prime mover is of proper phase.

Pin Puller - Device to permit removal of large sized close fitting pins from S-IC stage handling equipment.

Security Escort - Vehicles and men provided by Security to lead and follow S-IC stage caravan and provide traffic clearance and security.

Tank Sense Line - Hose connected to propellant tanks to measure internal pressure within the tank during movement of S-IC stage.

Tank Supply Line - Hose connected to propellant tanks to maintain positive pressure in tanks during movement of S-IC stage.

Vert cg - A lifting point for vertical center of gravity.

Wonder Building - Roofed cargo area on ocean-going barges where S-IC stage is stored during barging operations.

ABBREVIATIONS.

ac	alternating current	fs	full scale
accel	accelerometer	ft	foot
assy	assembly	g	gravity
aux	auxilliary	GN ₂	gaseous nitrogen
cal	calibration	humid	humidity
co.	company	in.	inch
cg	center of gravity	in-lb	inch-pound
dia	diameter	ind	independent
ECP	Engineering Change Proposal	KSC	Kennedy Space Center
F	Fahrenheit	kw	kilowatt

ABBREVIATIONS. (Continued)

LOX	liquid oxygen	psid	pounds per square inch differential
MAF	Michoud Assembly Facility	psig	pounds per square inch gage
max	maximum	ref	reference
md	multiple duty	rev	revision
mph	miles per hour	RP-1	rocket propellant fuel
ms	multiple service	rpm	rounds per minute
MTF	Mississippi Test Facility	SAE	Society of Automotive Engineers
MSFC	Marshall Space Flight Center	sta	station
na	not applicable	stby	standby
NASA	National Aeronautics and Space Administration	temp	temperature
no.	number	tp	tank pressure
pos	position	v	volts
PPCU	Portable Pneumatic Calibration Unit	VAB	Vertical Assembly Building
press.	pressure	vac	volts alternating current
psi	pounds per square inch	wt	weight
psia	pounds per square inch absolute		